CHARACTERIZATION OF OKLAHOMA'S FOREST HARVESTING INDUSTRY

By

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CHARACTERIZATION OF OKLAHOMA'S

FOREST HARVESTING INDUSTRY

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PREFACE

Characterization of Oklahoma's forest harvesting industry was the goal of this study. This was the first research in Oklahoma aimed at characterizing the industry. A census of all population members was the primary means of data collection. Important industry statistics reflecting the industry's economic condition were compiled as well as shipment, equipment, labor and detailed cost information.

I am deeply thankful to Oklahoma State University faculty and personnel who assisted me with this work. I offer special thanks to Dr. D. K. Lewis, my major adviser, who guided me through all the phases of this research while allowing me the responsibility and freedom necessary to get the utmost from the learning experience. I also thank my other committee members, Dr. R. F. Wittwer and Dr. Jim Summers.

Dr. Tom Lynch and Mr. Keith Harris offered invaluable assistance with the computer analysis. Andy Wheatcraft was instrumental in helping compile the mailing lists. Dr. Jim Gentry's advice insured the questionnaire would be a success. I thank Irene Larson for her patience and expertise in typing the manuscript.

I offer special thanks to Weyerhauser Company for their cooperation in the survey and to the Weyerhauser Foundation for their financial support.

Deepest thanks go to my wife, Sharon, and my daughter, Helena, for their help, support, and understanding.

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CHAPTER I

INTRODUCTION

The recent oil industry slow-down clearly demonstrated the undesirable effects of state economies based solely on a few major industries. This is a problem that Oklahoma, as well as many other states, has found to be all too real (Nigh, 1984). Promotion and development of diverse industries is the key to avoiding a narrow economic base, and its potentially adverse consequences.

Because of the current under utilization, Oklahoma's forest resources are seen as one potential source of economic diversification (TVA, 1982). It has been estimated that growth exceeds harvests in eastern Oklahoma forests by approximately 10 million cubic feet per year (Thomas, 1985). In 1984, 12 percent of the Gross Product of the state was provided directly by the primary processing component of the forest products industry. The regional impact of the industry is also much greater than it appears because of its concentration in the southeastern region of the state. This region is considered to be one of the least developed in the state. Increased utilization of Oklahoma's forest resources could be a significant boost to its economy.

An important component of the forest products industry is the forest harvesting industry which is responsible for delivering the forest resources to the primary processing facilities. The United States Department of Commerce Census of Manufacturers and Producers information

for Logging Camps and Logging Contractors (SIC Code 2411) (1977) indicated that the harvesting segment of the forest products industry was responsible for 10 percent of the value added to the industry. It also indicated that the total value of shipments for establishments increased by 146 percent from 1972. The 1982 Census of Manufacturers and Producers indicated that total value of shipments increased by 25 percent from 1977.

Assessment of the potential contribution of the harvesting industry to the full utilization of Oklahoma's forest resource should begin with a description of the current condition and contribution of the harvesting industry. Although sources such as the Census information are helpful, there is a shortage of current specific information regarding the structure and characteristics of the Oklahoma harvesting industry. There has been considerable work recently analyzing the costs and composition of harvesting systems for the southern pine region in general (Massey, et al., 1981) (Czerepinski, 1980) (Cubbage and Granskog, 1982). This information should be directly applicable to the southern pine region of the state. Oklahoma, however, is a transitional state. It varies from southern pine in the southeast portion of the state, to predominantly hardwood in the central and northeast region to prairie in the western region (Figure 1). Because of its diversity, the Oklahoma forest industry, and consequently, the forest harvesting industry, is unique. The previous works mentioned do not address the variable resource and market conditions of Oklahoma, and are therefore, not entirely adequate.

The goal of this paper is to define the current state of Oklahoma's forest harvesting industry. Identification, description, and analysis

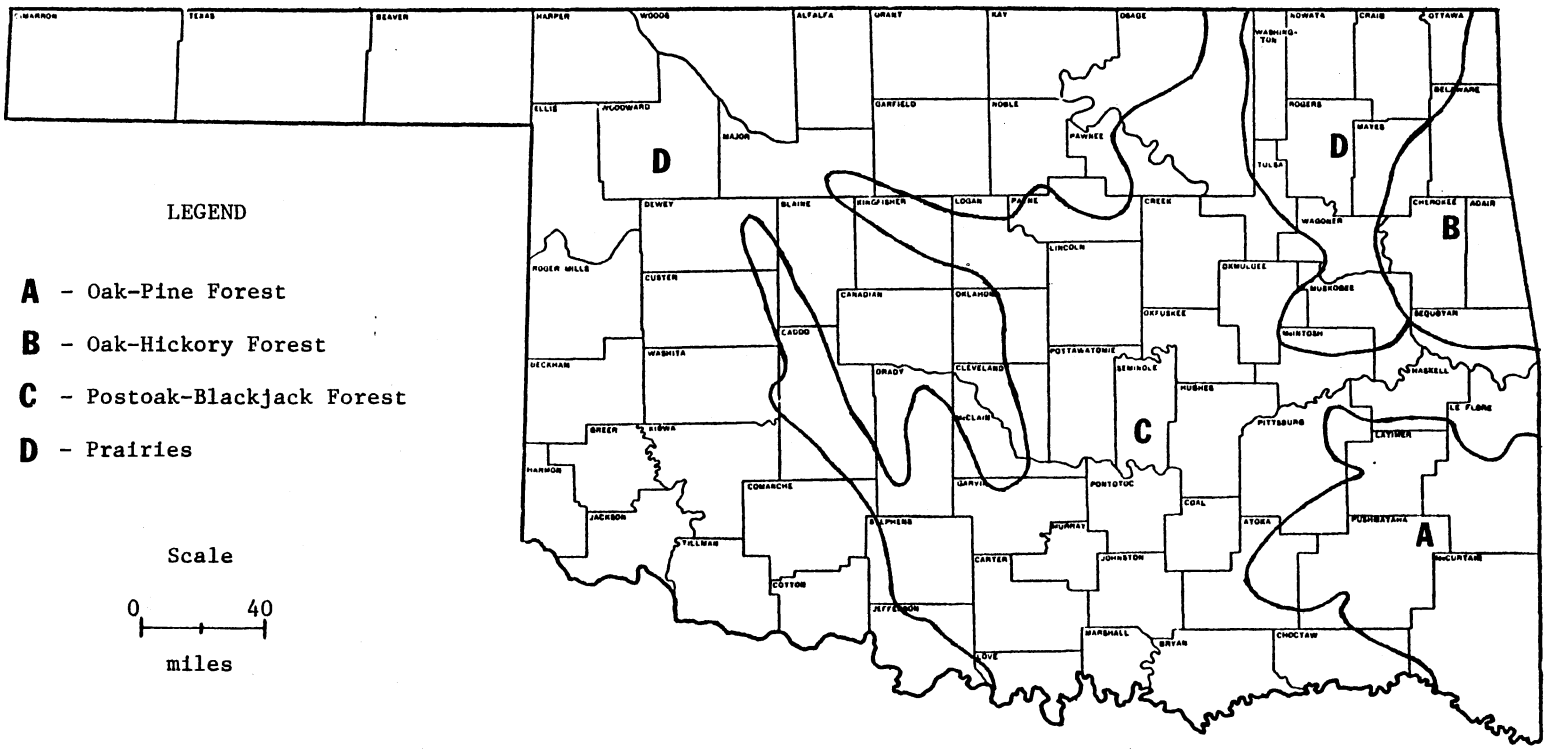

Figure 1. Vegetation of Oklahoma

of the prevalent forest harvesting systems in use in each region is sought, as well as an overall economic "picture" of the industry. The specific objective is to provide the following industry statistics:

1. Employment
2. Payroll
3. Value of Shipments
4. Cost of Materials
5. Value Added by Manufacture
6. Net Income and Return on Income

This information should be useful to decision makers at the corporate and governmental levels. More detailed information, useful to logging contractors, woods foremen, and job level managers is also sought:

1. Shipment Amounts
2. Labor Wage Rates and Costs
3. Fixed and Operating Equipment Costs

CHAPTER II

REVIEW OF LITERATURE

Primary Information

Information Characterizing the Oklahoma Forest Harvesting Industry

Primary information characterizing the Oklahoma forest harvesting industry is relatively scarce. The U.S. Department of Commerce, Census of Manufacturers and Producers (1982), for Logging Camps and Logging Contractors (SIC Code 2411) was expected to provide forest harvesting industry statistics for Oklahoma. Although it did indicate that employment decreased by three percent from 1977, and the total value of shipments increased by 25 percent, other more detailed information normally provided by this source was not available. Information on payroll, wages, value added, cost of materials, and value of shipments was withheld by the Census of Manufacturers and Producers at the request of the Oklahoma forest industry.

In the process of collecting information for publishing the Oklahoma State Department of Agriculture, Marketing Industry Division and Forestry Division, 1985-1986 Oklahoma Forest Industries Buyer's Guide (1985), the Division of Forestry accumulated some information concerning the forest harvesting industry. The primary source of data for the Buyer's Guide was a questionnaire distributed to the primary and

secondary forest industry of Oklahoma and surrounding states. A few of the questions in the questionnaire dealt with harvesting. However, the information collected by the questionnaire was general in nature and in most instances incomplete. In fact the published Buyer's Guide includes no harvesting information whatsoever. The most important aspect of the Buyer's Guide is that it provided one of the most recent and complete lists of names and addresses of forest industry producers. This list was vital for locating the harvesting industry producers for direct data collection.

A report by Sarles and Luppold (1986) gives insight into why certain forest harvesting systems predominate in some areas but not others. Sarles and Luppold point out that harvesting contractors in some areas have not embraced new capital-intensive systems because of market uncertainty, not ignorance. The threat of quotas and mill block-outs causes contractors to resist incurring the high fixed costs of the more efficient capital-intensive systems. It was thought that the results of this study might tend to reinforce Sarles and Luppold's findings.

Oklahoma Forest Harvesting Statistics

Several Oklahoma forest industry publications give at least some insight into the harvesting sector of Oklahoma's forest industry. Rudis and Jones (1981) present estimated volumes, prices, and cash receipts for forest products produced by the Oklahoma forest harvesting industry in 1978. In 1978, industrial roundwood was the fifth ranked agricultural commodity of the state when comparing total cash receipts. The total value of industrial roundwood from Oklahoma in 1978 was $46,790,000.

These figures are valuable for forming a basis for comparing the shipment results for this study.

The Oklahoma Midcycle Survey (Thomas, 1985) used a new sampling procedure based on prior survey data and current photography to survey changes in Oklahoma's forest resources. Thomas' survey indicates that growth currently exceeds harvests in Oklahoma by approximately 10 million cubic feet. Thomas indicates that annual removal of softwood during the period 1976-1981 averaged 55.2 million cubic feet, and hardwood removal for the same period averaged 32.3 million cubic feet.

Wheatcraft and Lewis (1986) released a report estimating Oklahoma's forest resource in terms of biomass. This is a significant report in that most previous published estimates of Oklahoma's forest resources were expressed in terms of forest resources suitable for production of traditional roundwood products. The report by Wheatcraft and Lewis reveals that a large portion of Oklahoma's actual forest resource is not being utilized by traditional forest harvesting technology.

Wheatcraft and Lewis indicate that of the estimated 358 million total tons of biomass in Oklahoma, 100 million tons is located on unproductive forest land, 86 million tons of which is recoverable for fuel. This is primarily forest land occupying the transition zone known as the "cross-timbers" between the eastern commercial forests of Oklahoma and the western prairies (Figure 2). It constitutes approximately two million acres of Oklahoma's total seven million acres of forest land. This timber is mostly blackjack and post oak (Quercus marilandica and Quercus stellata). These species have limited uses other than fuel.

Of the 258 million tons of biomass on productive forest land, only 145 million tons is stemwood suitable for conventional roundwood

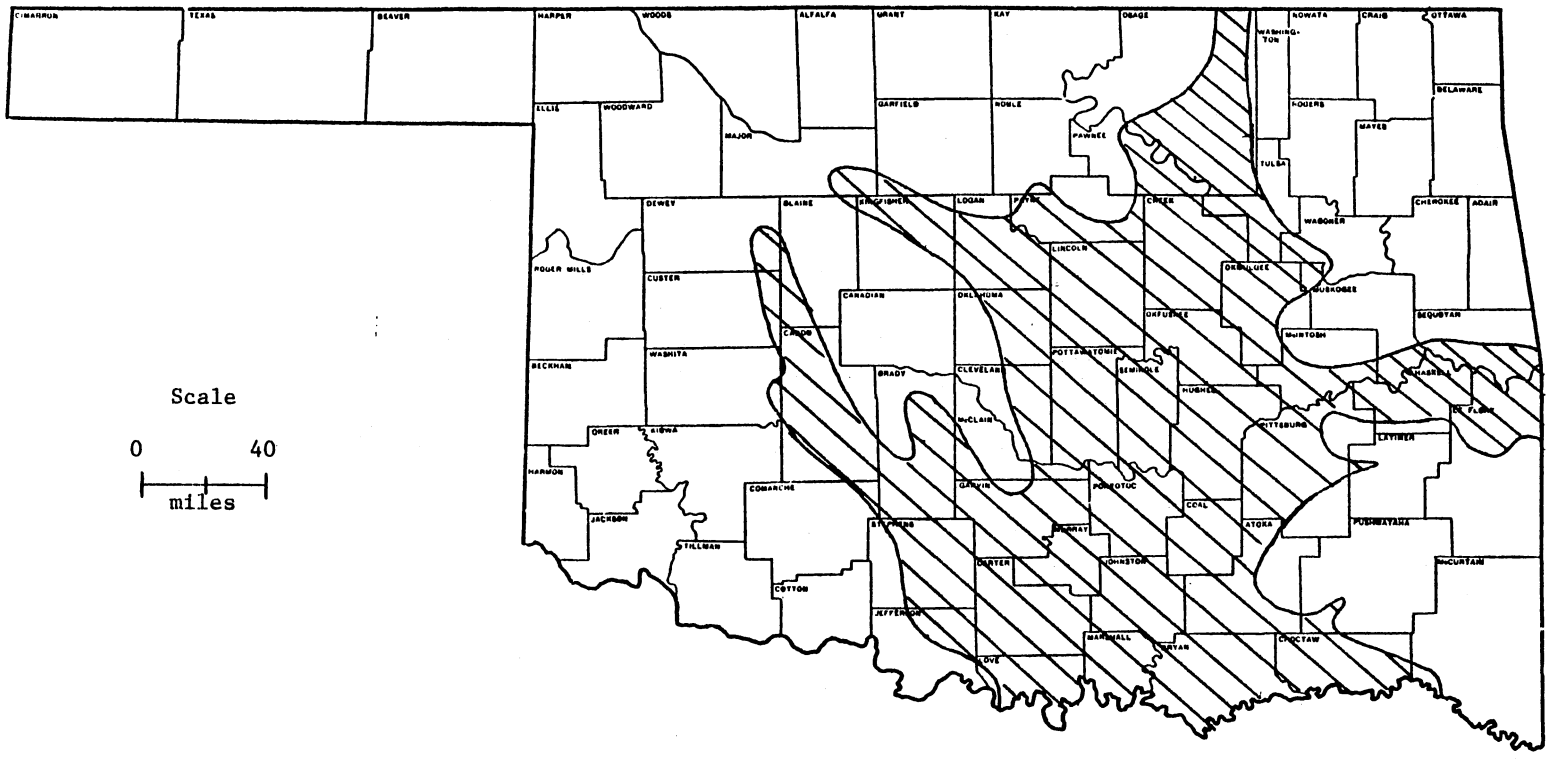

Figure 2. The "Cross Timbers" of Oklahoma

production. Of the remaining 113 million tons of biomass, 78 million tons is recoverable for fuel. These biomass estimates indicated that Oklahoma has a potential fuelwood resource of approximately 146 million tons as of 1976. Further it was estimated that this resource is increasing at a rate of approximately six million tons per year. There could be as much as 189 million tons at the present time. Although current forest harvesting technology such as whole-tree chipping is available to utilize much of this resource, it remains virtually untapped at present. Adequate markets for fuelwood in Oklahoma have simply not emerged.

Prices for stumpage and delivered timber were obtained from Timber Mart South (1985). Timber Mart South is a monthly publication which has three paid reporters in Oklahoma who take approximately 60 sample prices each month. These figures are then compared with the finding of other sources, if available.

A survey by Stuart and Shartle (1977) for the American Pulpwood Association which contacted forest industry throughout much of the nation predicts an increase in the harvest of solid wood products in the Southeast of 134,000 cords per year from 1980-2000; an increase in round pulpwood harvesting of 1,073,000 cords per year from 1980-2000; and an increase in whole-tree chip harvesting of 875,000 cords per year for the same period.

Secondary Information

Forest Harvesting Practices

Before attempting to characterize a regional harvesting industry

about which little previous study has been made, it was useful to have reference to publications that describe current forest harvesting practices and techniques. Even though Oklahoma has diverse forest types, these publications give an indication of forest harvesting techniques that might be associated with given forest types.

Conway (1982) gives a detailed description of regional forest harvesting practices. His work deals primarily with North American forest harvesting techniques. Staaf and Wiksten (1984), give a description of forest harvesting techniques from an international perspective. This book is especially useful for gaining insight into current European forest harvesting practices. Many regional studies of forest harvesting practices are also available. Czerepinski's (1980) description and analysis of harvesting systems in use in Georgia should be applicable to the harvesting industry in southeast Oklahoma.

Harvesting Equipment Ownership and Operating Costs

The most complex and difficult task in analyzing forest harvesting expenses is determining fixed and operating costs of harvesting equipment. It was suspected that many forest harvesting managers in Oklahoma, as elsewhere, have little or no idea of the nature of their equipment expenses. Thus, it was expected that direct collection of equipment expense data would be difficult, if not impossible. Fortunately, researchers have addressed the problem of determining methods and procedures for calculating forest harvesting equipment costs.

Werblow and Cubbage (1986) used machine rate formulas to calculate fixed and operating costs of most types of forest harvesting equipment

(Appendix A). They also presented a paper to the American Society of Agricultural Engineers (Cubbage and Werblow, 1985) analyzing the trends in equipment costs since 1967. The work done by Cubbage and Werblow provides both suggested calculation methods and cost estimates for various harvesting equipment.

Miyata (1980) deals specifically with methods of determining fixed and operating costs of logging equipment. Like Werblow and Cubbage, Miyata uses machine rate calculation methods that have been generally accepted in the industry. These methods are also illustrated by Mathews (1942), Day (1973), and Caterpillar (1984). This report draws heavily on Miyata's detailed explanations of methods of cost calculation. The methods and material section of this report deals with the exact formulas and procedures. Miyata also provides practical examples of cost calculation for selected machines.

Miyata and Steinhilb (1981) analyzed three popular methods for calculating machine rates. The first method bases calculations on scheduled operating hours. The second method, which was used in this report, bases calculations on actual productive hours or actual hours that the machines operate. This method seems the most realistic and is also used by Miyata (1980) and Werblow and Cubbage (1986). The third method uses scheduled hours for calculating fixed costs and productive hours for calculating operating costs. Miyata and Steinhilb demonstrated that either the first or second methods are acceptable as long as the basis for calculation is clearly understood, but that the third method is incorrect from both a realistic and mathematical standpoint.

Georgia Kraft Corporation has made available machine cost and rate information compiled by Plummer (1982). Plummer's findings are

comparable to those of Werblow and Cubbage (1986).

The Southwide Energy Committee of the American Pulpwood Association Inc. has been responsible for many reports dealing with forest harvesting equipment costs. A series of reports by Plummer and Stokes (1985 a, b, c) for the American Pulpwood Association dealing with off-highway forest machine petroleum product consumption and on-highway forest transportation petroleum product consumption were especially useful for calculating petroleum costs.

Harvesting Systems Cost Analysis

The availability of powerful, economical computers has led many researchers to model total forest harvesting systems. The modeling approach uses the computer's high speed calculation ability to incorporate the many diverse variables of a forest harvesting system into the cost analysis procedure.

Cubbage and Granskog (1982) used the Harvest System Simulator (HSS) computer program (Stuart, 1981) to analyze ten popular harvesting systems representing a range of mechanization levels in use in the southern states. Cubbage and Granskog determined that the highly mechanized full-tree systems are the most cost-efficient, but that these systems must maintain stable high volumes of output.

Cubbage also used the Harvest System Simulator to explore the effect of tract size on harvesting costs (Cubbage, 1983). He simulated several representative harvesting systems to assess the effect of tract size on average harvesting costs. It was discovered that highly mechanized tree length systems become superior to labor-intensive systems on tract sizes of 20 to 30 acres and larger.

Summary of Literature

As this chapter clearly demonstrates, there has been considerable research recently concerning the forest harvesting industry. One of the most valuable contributions of these researchers is the introduction of standardized methods and procedures for analyzing harvesting systems and their components. However, current, specific information characterizing Oklahoma's forest harvesting industry does not exist. What harvesting systems are currently being used in Oklahoma? How large is the industry? What is the employment? What is the Oklahoma industry's current economic condition? These are the questions this study seeks to answer. Work by Cubbage, Miyata, Plummer, Stuart, and others will make this task much easier.

CHAPTER III

METHODS AND MATERIALS

Study Population

The Oklahoma forest harvesting industry constitutes the study population of this research. The industry was defined as all firms, including those based in other states, which at the time of the survey, had harvested timber in Oklahoma during the preceding year or intended to harvest timber during the next year. A census of the members of the study population was the primary means of data collection. However, as much data as possible was collected from previously compiled sources to avoid unnecessary repetition of previous work, and to lessen as much as possible the burden of direct data collection on the population members.

Survey

Methods

After determination of the necessity of a survey to collect the needed data, the first important decision was the method or methods of surveying to implement. Three methods were identified: survey by mail, telephone, or personal interview. The method of survey chosen was influenced by such factors as: questionnaire content and length, size of study population, cost, and time restrictions.

The estimated study population of less than 300 led to the decision

to conduct a census rather than a sample survey. A census eliminates any uncertainty due to sampling procedures.

Survey by personal interview was ruled out except for one especially large firm in southeast Oklahoma. The estimated population size and manpower restrictions made this otherwise desirable method unfeasible. The choice of survey method was thus narrowed to telephone or mail. Previous surveys of forest industry in Oklahoma (Thompson, 1978) have indicated better response to telephone survey than survey by mail. However, due to cost considerations, it was decided to combine the two methods. The questionnaire was first mailed to the population members, and then an attempt was made to contact all non-respondents by telephone.

The questionnaire was first mailed in June of 1986, with a personalized cover letter explaining the need and importance of the survey. It was followed two weeks later with a personalized letter to all the potential respondents urging them to complete and return the questionnaire. Four weeks after the initial mailing, the questionnaire was again mailed to all non-respondents along with another letter urging response. A final letter to non-respondents was mailed two weeks after the second questionnaire mailing.

Three weeks after the final letter, the process of contacting all non-respondents by telephone was begun. A period of approximately one month was necessary to complete the telephone portion of the survey.

Mailing List

Before the survey could be implemented the study population had to be identified. Names, addresses, and telephone numbers were needed.

There was no known complete list of Oklahoma forest harvesting firms. However, fairly complete lists of primary forest producers were available. Since forest harvesting firms must sell or otherwise deliver their product to a primary producer (except for firewood producers), as many primary producers as possible were contacted concerning their knowledge of forest harvesting firms. Primary producers who did not respond to written inquiries were contacted by telephone. Lists of harvesting firms were also requested from state district foresters and county extension agents.

Questionnaire Design

Interviews and conversations with university and public surveying specialists indicated that the key to good survey response, and ultimately a successful survey, was the questionnaire design. The questionnaire had to be brief, unintimidating, clear, concise, and free of ambiguities. The original questionnaire was submitted to many individuals for comment and suggestion.

One important decision early in the questionnaire design process was to not seek detailed expense information for all population members. The literature search revealed several sources of expense calculation information and techniques (Werblow and Cubbage, 1986) (Miyata, 1980), that would yield satisfactory results. Deleting the collection of this information was essential to shortening the questionnaire sufficiently to conduct by telephone. The primary questionnaire sought four major types of information: demographic information, production, employee and pay rate information, and equipment type and age (Appendix B). The questionnaire asked if the respondent maintained

detailed expense records and if the respondent would share the information. Participants who answered yes to this question were sent detailed expense questionnaires (Appendix C). Information from this questionnaire was used to check the results of the expense calculation techniques previously mentioned.

The final step in designing the primary questionnaire was pretesting it on a small group of forest harvesting firms. The questionnaire was mailed to 20 forest harvesting firms in Louisiana along with a cover letter asking for any comments or suggestions.

The final questionnaire design reflected the input of literally dozens of individuals from professors to loggers. For simplicity and convenience the final questionnaire was designed as a small eight page booklet capable of being mailed to the respondents in a standard business envelope. The booklets were self-addressed and stamped so that the repondents had simply to answer the questions and drop the booklets in the mail.

Implementation

Several months prior to the first mailing of the questionnaires, notice of the proposed survey was given in the Oklahoma Forest Industry Bulletin (1986) and through state district foresters and county extension agents. Implementation of the questionnaire was begun in the first week of June 1986, and completed by the end of September 1986. A microcomputer was used to generate personalized cover and follow-up letters from the mailing list. One large firm in southeast Oklahoma was personally interviewed in June 1986.

Means of Analysis

Data Manipulation

Information from the questionnaires was coded on FORTRAN computer forms. The Oklahoma State University computer keypunch service entered the data into the university main-frame computer system. Data verification was also provided by the computer keypunch service. The computer statistical package SAS, provided by the SAS Institute Circle, P.O. Box 8000, Cary, North Carolina, was used to analyze the data. The data were organized into four data sets: demographic information, shipment information, employment information, and equipment information.

The four data sets were sorted and analyzed by region. The regions are: Northeast Oklahoma, West Oklahoma, Southeast Oklahoma, Kansas, Missouri, Arkansas, and Texas. The equipment and employment data sets plus stumpage values derived from the shipment information formed the basis for calculating the industry expenses from each region for 1985. The shipment data set formed the basis for calculating the amount and value of the shipments generated by each region. Total industry expenses and shipment values were obtained by summing the regional figures.

Equipment Analysis

Equipment expense information was determined by calculating the fixed and operating expenses for each type of equipment reported for each region. The expense items calculated for each equipment type were: depreciation, interest, licenses, taxes, insurance, fuel, lubricants, repair, maintenance, and tire and track expenses.

Depreciation expense was calculated by the straight-line method illustrated by Equation (3.1).

Depreciation = (Initial investment - salvage value)/
total hrs. or miles (3.1)

The initial investment costs were obtained from equipment dealers, the Green Guide (1986), the Specifications for Construction Equipment (1986), and the NADA Official Used Car Guide (1986). Salvage value was calculated as 20 percent of the delivered price of the equipment (Miyata, 1980). The yearly estimated hours or miles for each equipment type was determined by multiplying the average days worked per year reported on the questionnaire by eight hours per day. This yearly figure was then multiplied by the estimated ownership period in years (Plummer, 1982) (Werblow and Cubbage, 1986) (Miyata, 1980). Finally, in order to allow for equipment delays due to breakdowns, personnel, weather, etc., the total estimated hours or miles were multiplied by utilization factors (Miyata 1980) to yield total productive hours.

Interest expense per hour or mile was determined by multiplying the average annual investment by the annual interest charge and dividing by the annual operating hours or miles. Equation (3.2) was used to determine average annual investment (Miyata, 1980) (Werblow and Cubbage, 1986).

$$\text{Average Annual Investment} = \frac{(I - R)(N + 1)}{2N} + R$$

I = initial cost
R = residual or salvage value
N = number of years of equipment ownership (3.2)

An annual interest charge of 12% was used. This rate was chosen as a result of conversations with harvesting contractors. It is probably a good average figure considering the variable ages of equipment.

The interest rate chosen has a pronounced effect on the interest expense. It should therefore, be considered carefully. Consider for example, an $80,000 skidder with an ownership period of 5 years and salvage value of $16,000. The average annual investment from equation (3.2) is $54,400. The average annual investment multiplied by a 12 percent annual interest rate results in an annual interest expense of $6,528. However, if the interest rate only is changed to 13 percent the annual interest expense rises to $7,072 annually. The one percent change in interest rate results in an eight percent or $544 change in the average annual interest expense. This eight to one relationship holds regardless of the equipment purchase price.

Licenses, taxes, and insurance costs per operating hour or mile were calculated by dividing their annual costs by the estimated annual operating hours or miles. The prevailing insurance rates were obtained from area insurance agents. License and tax expenses were obtained from the appropriate government agencies.

Maintenance and repair costs were estimated as a percentage of hourly depreciation cost (Miyata, 1980). The annual depreciation cost times the percentage rate for the particular equipment type (Miyata, 1980) divided by the estimated productive time per year yielded the estimated maintenance and repair cost per hour or per mile.

Hourly fuel cost for off-road machinery was calculated according to Equation (3.3) or Equation (3.4) depending on whether the machine was gasoline or diesel powered (Miyata, 1980).

For diesel engine: .037 x hp x cost per gallon (3.3)

For gasoline engine: .050 x hp x cost per gallon (3.4)

hp = net horsepower at rated engine speed.

Fuel costs per gallon were obtained from local dealers. Horsepower figures were obtained from the questionnaire and the Specifications for Construction Equipment (1986). On-highway vehicle fuel costs per mile were calculated by dividing local fuel costs per gallon by miles per gallon figures reported by Plummer and Stokes (1985 a, b, c).

Off-road machinery engine oil costs were calculated by Equation (3.5) (Miyata, 1980).

$$\text{Hourly engine oil cost} = \left(.0005 \times hp + \frac{C}{t}\right) \times \text{cost per gallon}$$

hp = net horsepower of engine
C = capacity of crank case in gallons
t = number of hours between oil changes (3.5)

Net horsepower figures were taken from questionnaire averages. Crankcase capacities and number of hours between oil changes were obtained from the Specifications for Construction Equipment (1986). Fifty percent of engine oil cost was used for other lubricants (Miyata 1980). On-highway vehicle lubricant expenses were calculated from figures reported by Plummer and Stokes (1985 a, b, c).

Hourly tire cost for off-road machinery was calculated according to Equation (3.6) (Miyata, 1980). Estimates of tire life and cost

$$\text{Hourly tire cost} = 1.15\ (\text{tire cost})/\text{tire life} \qquad (3.6)$$

were obtained from survey respondents. Response from survey participants also provided the basis for determining on-highway vehicle tire costs and track costs for tracked vehicles.

Employment Analysis

Employment data from the questionnaire were used to calculate payroll and labor costs for each region by job description. Survey respondents were asked to list employees with multiple jobs by their

major job description.

Payroll expenses for 1985 were calculated by multiplying the number of employees in each job description by the average daily wage reported for each job description times the average number of days worked. Total labor costs were determined by adding the yearly social security, federal and state unemployment, and workmen's compensation expenses to the payroll expenses. The Federal Internal Revenue Service provided the federal unemployment insurance and social security rates for 1985. State insurance commissions were contacted for 1985 workmen's compensation rates. State employment commissions provided state unemployment rates for 1985.

Shipment Analysis

Survey respondents were asked to provide estimates of their shipments harvested in Oklahoma for the years 1983, 1984, and 1985. Stumpage expenses for 1985 for each region were calculated by multiplying reported shipments by the average stumpage costs for the year as reported by Timber Mart South (1985). Harvesting industry revenues for each region for 1985 were calculated by multiplying the average delivered price for the year as reported by Timber Mart South (1985), by the reported shipment amounts.

CHAPTER IV

RESULTS AND DISCUSSION

Questionnaire Response

Response Rate

The most important consideration in designing the questionnaire was getting a high response rate. The rate of response to the written questionnaire was expected to be in the range of 10 to 25 percent. Fortunately, the actual response rate to the written questionnaire was approximately 35 percent. At the conclusion of the telephone portion of the survey 297 respondents had been contacted. There were 377 attempted contacts, which indicates the total response rate was 79 percent (Table I).

Over 96 percent of the non-respondents were firms that could not be reached by mail or telephone. The written questionnaires came back non-deliverable and directory assistance was unable to provide telephone numbers. It is suspected that many of these firms no longer exist, but undoubtedly a few working firms were missed. Only one percent of the 297 firms contacted refused to cooperate.

Over 12 percent of the firms contacted reported going out of business within the last year. This was a surprisingly large number. It seemed to indicate that the industry is in poor economic condition.

Approximately 43 percent of the firms contacted reported doing no

TABLE I

SURVEY RESPONSE RATE

	Number	Percent
Potential Loggers unable to contact by phone or mail	80	
Loggers now out of business	37	12%
Loggers not working in Oklahoma (don't plan to work in OK in near future)	127	43%
Study Population (loggers working in OK)	130	44%
Loggers unwilling to cooperate	3	1%
Total loggers contacted	297	100%
Total loggers (attempted to contact)	377	
Total survey response rate - 79%		

work in Oklahoma. This number was expected because the survey was sent to large numbers of firms in adjacent states, not knowing whether or not these firms actually worked in Oklahoma.

Response to the survey indicated that the actual size of the Oklahoma forest harvesting industry was approximately 130 individual firms. This number does not include short pulpwood, firewood, or fence post contractors.

There are significant short pulpwood, firewood, and post markets in southeast Oklahoma. Because these small operators work through dealers, who buy the timber at rail or truck concentration yards and then ship the timber to the primary user, it was exceptionally difficult to locate the haulers. It was decided to obtain the information from the dealers for these markets.

It was found that there are currently nine short pulpwood dealers with approximately 155 individual contractors operating in Oklahoma. This is, however, a very volatile number. Many of these operators work only part-time and this segment of the industry experiences continuous entry and exit due to the relatively low pay and high degree of manual labor involved. Many of these operators also haul fence posts at times (Table II).

Three post dealers were found to have at least 25 individual contractors currently operating in Oklahoma (Table II). Again, this is a very volatile segment of the industry for the same reasons described for the short pulpwood market.

Although there was some response from firewood contractors, the response was so low that not even a rudimentary assessment of this industry segment was possible. The big problem was an inability to

TABLE II

SHORTWOOD MARKET (approximate)

Markets	Dealers	Contractors	Employment	Shipments (1985)
Short Pulpwood	9	155	400	271,250 tons (approx. 40% hardwood 60% pine)
Posts	3	25	30	43,750 tons (pine)

locate these producers since they often do their own marketing. It was determined that many shortwood and post contractors also were engaged in firewood harvesting. But, there was also indication of individual contractors involved in firewood harvesting only.

Geographic Distribution

Of the 130 total firms identified, 110 were located in Oklahoma (Figure 3). The southeast region of the state accounted for 74 percent of the Oklahoma based firms responding to the survey, the northeast region 15 percent, and the western region 11 percent. Of the remaining 20 firms: two were based in Kansas, eight in Arkansas, seven in Missouri, and three in Texas. These figures seem reasonable since the majority of Oklahoma's primary forest producers are located in the southeast region of the state.

General Information

It was found that many firms subcontracted some phases of their harvesting operations. For instance, 33% of the firms surveyed subcontracted at least a portion of their trucking. However, for simplicity this research considers these subcontractors as employees of the firms for which they work. It should be remembered though that in actuality many of these firms prefer a subcontractor business arrangement.

The detailed expense questionnaire (Appendix C) was mailed in August to 16 of the 45 written primary questionnaire respondents. These 16 firms indicated on their primary questionnaires that they would share their expense information. Of these 16 firms only 6 actually returned the expense questionnaires. Table III compares the actual reported

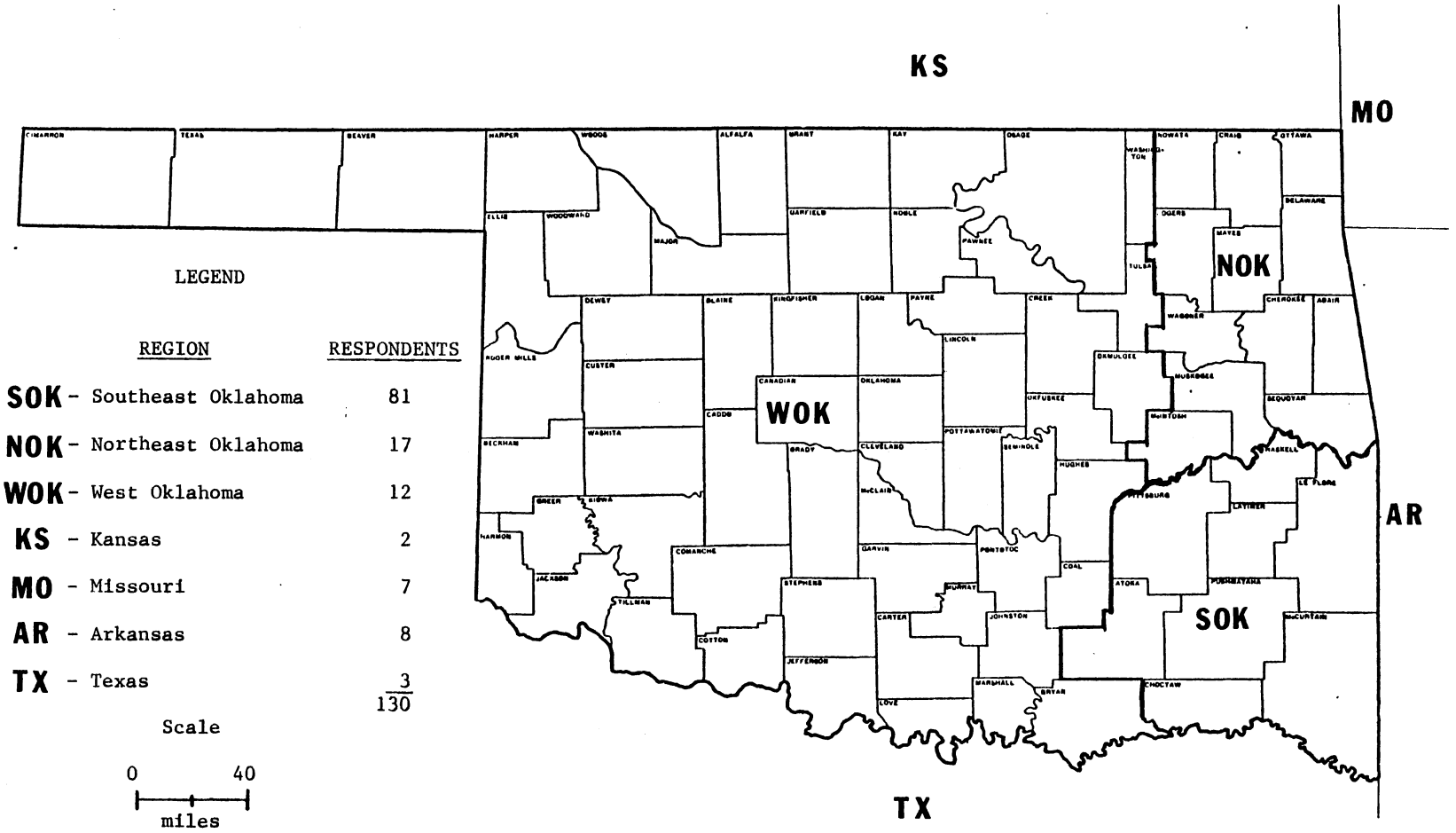

Figure 3. Geographic Distribution of Forest Harvesting Firms Responding to Survey

TABLE III

COMPARISON OF ACTUAL AND ESTIMATED OPERATING EXPENSES

Respondents	Actual Equipment Operating Expenses	Estimated Equipment Operating Expenses	Deviation of Estimate from Actual
A	$ 6,642	$ 8,947	+25%
B	14,494	18,284	+21%
C	22,237	25,945	+14%
D	23,460	26,309	+11%
E	141,389	136,352	- 3%
F	785,383	619,920	-21%

equipment operating expenses for the six firms with the operating expenses that were calculated using the procedures described in Chapter III (Miyata, 1980). This comparison was made to see if the estimation procedures used in this study were providing an adequate estimate of the true equipment expenses. It was found that the operating expenses of four firms were overestimated but that the other two firms' operating expenses were underestimated. The small number of firms responding to the expense questionnaire prevents the drawing of firm conclusions in regard to the estimation procedure, but the existence of both over-estimates and underestimates seems to indicate the absence of significant bias.

Industry Statistics

Number of Establishments

There are approximately 310 forest harvesting firms. Of this number, 180 are small shortwood pulp and post contractors who work through the dealer system. The firms range in size from those employing only one individual to those employing 30 or more workers. The firms harvesting southern pine sawtimber in southeast Oklahoma are the largest and most highly mechanized. Firms harvesting shortwood pulpwood, posts, and hardwood sawtimber are the smallest and most labor-intensive.

Employment and Payroll

Approximately 1,128 people are currently employed by the Oklahoma forest harvesting industry. It must be remembered, however, that many of the people also harvest timber in other states. Table IV gives the

TABLE IV

EMPLOYMENT INFORMATION

Job Description	Number Employees	Average Daily Wage (dollars) (8-hour day)	Average Hours per week
Chainsaw Operators	224	73.5	39.7
Shear or Feller-Buncher Operators	15	79.7	41.1
Skidder Operators	162	67.7	40.5
Loader Operators (many truck drivers also loader operators)	25	68.6	41.7
Truck Drivers	234	63.7	45.0
Dozer Operators	8	72.2	40.0
Chipper Operators	2	96.0	60.0
Foresters	2	79.5	45.0
Managers	12	93.8	44.4
Mechanics	5	76.0	39.0
Administrative (secretaries)	9	35.3	28
Short pulpwood employees	400		
Post employees	30		
Total	1,128		

breakdown by job description and the average reported wage rates and hours worked per week.

The total estimated payroll of the Oklahoma forest harvesting industry for 1985 was $10,638,135. This figure reflects gross earnings of employees, and is calculated according to the U.S. Department of Commerce Census of Manufacturers and Producers (1982) guidelines. Detailed breakdowns of payroll and labor costs are presented in Appendix D.

Amount and Value of Shipments

The total estimated value of shipments produced by the Oklahoma forest harvesting industry in 1985 was $45,985,100. This figure reflects the total value of all timber delivered to the primary forest product producers. Calculation was according to the U.S. Department of Commerce Census of Manufacturers and Producers (1982) guidelines. The prevailing product prices were taken from Timber Mart South (1985). Table V summarizes the shipment amounts for Oklahoma. Appendix E gives the shipment amounts by regions.

Cost of Materials

Total estimated cost of materials of the Oklahoma forest harvesting industry for 1985 was $31,817,883. This figure was estimated by summing the estimated stumpage cost for 1985, $22,613,100, with the estimated equipment operating expenses, $9,204,783. Detailed stumpage values by region are given in Appendix E. Detailed equipment fixed and operating costs by region are given in Appendix F. Calculation was according to the U.S. Department of Commerce Census of Manufacturers and Producers (1982).

TABLE V

TOTAL SHIPMENTS BY PRODUCTS

	Weight (thousand tons)		
	1983	1984	1985
Pine Sawtimber	955.4	1,031.8	1,078.9
Hardwood Sawtimber	306.3	321.2	311.2
Hardwood Veneer	15.0	9.0	9.6
Poles/Piling (pine)	3.3	5.1	8.6
Pine Pulpwood (long wood)	361.3	333.2	333.5
Hardwood Pulpwood (long wood)	56.4	60.6	59.4
Fuel Chips	75.0	100.00	122.9
Pine Pulpwood (shortwood)			162.6
Hardwood Pulpwood (shortwood)			108.5
Posts			43.8

Value Added by Manufacture

The total estimated value added by manufacture of the Oklahoma forest harvesting industry in 1985 was $14,167,217. This figure was calculated by subtracting the cost of materials for the industry in 1985 from the total value of shipments. The U.S. Department of Commerce Census of Manufacturers and Producers (1982) guidelines were followed for calculation.

Value added by manufacture is a useful statistic because it gives an indication of the contribution of the industry to Oklahoma's economy. It can also be used to compare the relative efficiency of the industry with other Oklahoma industries. One key indication of efficiency is labor productivity which is calculated by determining the units of output resulting from given units of input.

Using figures from the U.S. Department of Commerce Census of Manufacturers and Producers (1982), it is estimated that Oklahoma manufacturers and producers on average produced $2.03 of value added by manufacture for each dollar of payroll in 1982. The results of this survey indicate that in 1985, the Oklahoma forest harvesting industry produced $1.33 of value added by manufacture for each dollar of payroll. Therefore, it appears that the forest harvesting industry is approximately 34 percent less efficient with its labor input than the average Oklahoma manufacturer or producer. The labor input efficiency for some other selected Oklahoma manufacturing industries in 1982 were: sawmills and planing mills, 1.61; paper and allied products, 2.98; petroleum and coal products, 4.62; and fabricated metal products, 2.09. A question that could arise is that maybe all forest harvesting

industries are inefficient with their labor input. To answer this question, the labor input efficiency was calculated for forest harvesting industries in some of the surrounding states. The results were: Arkansas, 2.58; Louisiana, 2.77; Mississippi, 1.98; and Texas, 3.65. These figures reinforce the impression that the Oklahoma forest harvesting industry needs to work hard to increase productivity by such means as: adopting new technologies and techniques, providing more and better personnel training, improving management techniques, reducing business risk so capital can be attained more easily, and reducing labor turnover and absenteeism through a more thorough screening of personnel and by improving the work environment. The labor productivity figures should be considered only approximations because the 1982 data used for the comparisons is rather outdated; however, it is the most recent available data.

Net Income and Return on Income

The most startling economic statistic revealed by this survey was the net income and return on income for 1985. According to the results of this survey net income was minus $5,066,093. This figure was calculated by subtracting total equipment, labor, and stumpage costs for 1985 from the total value of shipments. Detailed stumpage, equipment, and labor costs can be found in the Appendixes. The total equipment cost was estimated as $13,527,800. The total labor cost was estimated as $14,910,293. The total stumpage cost was $22,613,100. Return on Income which is calculated by dividing net income by the value of shipments was minus 11 percent of the industry.

In order to verify these figures and possibly gain some insight

into the apparent industry loss in 1985, a 10 percent random sample was made of individual firms in the survey. Return on income was calculated individually for these firms. The results of this sample are shown in Table VI). There was a very wide variance in return on income for the sampled firms. The figures range from +20 percent to -100 percent. It is interesting to note that while some firms made respectable profits many others had tremendous losses. This may help to explain why over 12 percent of the questionnaire respondents contacted reported going out of business during 1985. Investigating and verifying the exact cause of this apparent loss is beyond the scope of this research; however, two hypotheses will be presented.

The first hypothesis is based on impressions received while compiling the mailing lists for the questionnaire. It was noted that most harvesting firms involved in hardwood sawtimber production, especially in northeast and western Oklahoma, owned small sawmills as well. Apparently they also process the timber they harvest into lumber. It is possible that for this market the harvesting segment is actually a cost center for the primary producers, and the apparent loss sustained in harvesting is recaptured with the sale of the finished product.

Another possible explanation for some of the apparent loss has to do with the delivered price paid for timber in Oklahoma for 1985, as reported by Timber Mart South (1985). According to Timber Mart South from April 1985, to October 1985, the price for delivered pine sawtimber fell 21 percent and the price for delivered hardwood sawtimber fell 26 percent in southeast Oklahoma. Other product prices did not drop as drastically, but even a 15 percent average reduction in price for all shipments could possibly account for the loss. It is certain that the

TABLE VI

CALCULATION OF RETURN ON INCOME FOR INDIVIDUAL FIRMS
(10% random sample)

Southeast Oklahoma	Northeast Oklahoma	West Oklahoma
+ 8.8%	-87%	-46%
+ 16.0%	+18%	
-100%		
- 97%		
- 39%		
+ 20%		
- 31%		
- 16%		
- 67%		
- 1.0%		

harvesting industry expenses could not have been reduced at the rate that the price of shipments fell during 1985.

A possible explanation for the sudden price drop may be that also during this period many southern states were facing the worst epidemics of southern pine beetle infestations ever recorded. Timber salvaged from pine beetle infestations was flooding the market during this time period.

Significance of Oklahoma's Forest Harvesting Industry

The industry statistics previously presented may be more meaningful if given some perspective. The most recent data for the state of Oklahoma for manufacturers and producers (U.S. Department of Commerce, 1982), is used as the basis for comparison. These numbers should be considered only as approximations and subject to considerable variance, due to the age of the data. Also, the detailed data for McCurtain County, the most important forested county, had to be interpolated because the actual data was withheld by the Bureau of Census to protect a large forest products firm which dominates the county's economy.

When the forest harvesting industry is compared to Oklahoma's entire manufacturing economy, it appears rather insignificant. The forest harvesting industry constitutes approximately .6 percent of the employment. Its payroll constitutes .5 percent of the state's manufacturing payroll. The industry's value of shipments, cost of materials, and value added by manufacture each contribute .2 percent of their respective industry totals.

On a regional basis, however, the industry's importance is readily

apparent, because the forest harvesting industry is concentrated in the southeast region of the state (Figure 3). Using the total manufacturing statistics for the eight counties representing the southeast region of the state in Figure 3, as the basis for comparison, the forest harvesting industry represents 25 percent of the region's total manufacturing employment, 20 percent of payroll, 16 percent of value of shipments, 20 percent of cost of materials, and 11 percent of the value added by manufacture. These figures indicate that the health and growth of Oklahoma's forest harvesting industry is crucial to the economy of the southeast region of the state.

Discussion of Harvesting Systems and Capital Investment

Northeast and West Oklahoma

Harvesting firms that operate in northeast and west Oklahoma include all the firms from Kansas and Missouri as well as the firms located in northeast and west Oklahoma. These firms all fall in one of two categories depending on the product produced: hardwood sawtimber producers and hardwood veneer producers.

Most of the firms harvest hardwood sawtimber which is delivered to small local sawmills. Often the firm owning the sawmill also owns the harvesting operation. Typically, these harvesting operations consist of two employees. The equipment used is usually one chainsaw, one winch truck for skidding and log loading, and one bobtail, gasoline powered truck for transportation of logs to the sawmill. These operations are very seasonal; in fact, few of these firms work over 150 days per year.

Another interesting observation was that the equipment used by these firms is very old. Most of the bobtail trucks are at least 20 years old, and the winch trucks are often 30 years old (Table VII). The relatively old age of the equipment is probably due to the necessity of holding fixed costs to an absolute minimum due to the seasonality of the market. Capital investment for individual firms rarely exceeds $10,000. Because the equipment of these firms often sits idle for over half the year, the firms cannot survive unless they incur very low fixed costs. Unless there is a fundamental change in the market structure of the hardwood sawtimber industry in these regions, the associated harvesting industry will continue to employ low production, antiquated harvesting systems.

The other harvesting firms operating in northeast and western Oklahoma produce hardwood veneer logs. Most of the firms producing veneer logs are those based in Kansas and Missouri.

Typically, these firms employ one or two chainsaws, one cable skidder, a hydraulic knuckleboom loader, and two diesel trucks with pole trailers. Capital investment for these systems is generally between $200,000 to $300,000. The markets for these logs are located in central and northern Missouri. The product value, however, is high enough to warrant the long haul distances. The equipment is generally more modern than that employed by the hardwood sawtimber producers. Most of the equipment is approximately 10 years old (Table VII). Because of the speciality nature of the product, the current harvesting systems probably could not be improved significantly with currently available technology.

TABLE VII

NORTHEAST AND WEST OKLAHOMA EQUIPMENT

Machine Type	Number	Av. Horsepower	Av. Year Model
Chainsaws	38		--
Cable Skidders	13	85	75
Grapple Skidders	1	86	80
Dozers	2	120	65
Farm Tractors	4		67
Front-end Loaders	11		70
Loaders (knuckle-boom)	8	(15,000 lb. capacity @ 10 ft. from machine)	77
Bobtail Trucks	28		68
Gas Tractor-Trucks	12		73
Diesel Tractor-Trucks	7		73
Pole Trailers	14		74
Winch Trucks	12		53
Lowboys	5		71
Medium Pickups	2		65
Small Pickups	21		76
Forwarder	1	80	77
Float	1		78

Southeast Oklahoma

Harvesting firms that operate in southeast Oklahoma include all the firms surveyed that are from Texas and Arkansas as well as all the firms located in southeast Oklahoma. Most of the harvesting systems of this region fall into one of five categories: tree-length merchandising systems, highly mechanized pulpwood systems, bobtail pulpwood and post systems, bobtail hardwood sawtimber systems, and whole-tree chip systems.

These systems represent extremes in mechanization and capital versus labor mix. The bobtail pulpwood and post systems and the bobtail hardwood sawtimber systems are labor intensive with capital investments between $10,000 to $50,000. At the other extreme the whole-tree chip systems are highly mechanized and capital intensive. The capital investment of the whole-tree chip systems can exceed $1.5 million.

The bobtail hardwood sawtimber systems are very similar to those employed in northeast and west Oklahoma. The equipment is often 15 to 20 years old. The systems usually consist of one chainsaw, a winch truck, and a gasoline-powered bobtail truck. The trees are bucked into 9 or 18 foot logs. The capital investment is usually between $10,000 and $20,000. The harvesting operations are usually owned by the small sawmill owners.

The bobtail pulpwood and post systems are also labor intensive. The equipment is usually at least 15 years old (Table VIII). The capital investment is usually between $10,000 and $50,000. Most operations consist of one or two chainsaws and a gasoline-powered bobtail pulpwood truck with a "big-stick" winch loader on the truck.

TABLE VIII

SOUTHEAST OKLAHOMA EQUIPMENT

Machine Type	Number	Av. Horsepower	Av. Year Model
Chainsaws	740		
Feller-Bunchers	21	115	83
Directional Shears	1		74
Cable Skidders	90	97	77
Grapple Skidders	61	120	82
Loaders (knuckle-boom)	78	16,215 lb. capacity @ 10 ft. from machine	78
Delimbers	4		83
Dozers	29	138	72
Front-end Loaders	10	65	76
Farm Tractors	73	64	75
Chippers	2	750	78
Bobtail Trucks	249		71
Diesel Tractor-Trucks	168		78
Gas Tractor-Trucks	10		70
Pole Trailers	158		75
Lowboys	28		
Floats	3		73
Set-out Trailers	11		80
Chip Trailers	9		77
Large Pickups (1-ton)	24		78
Medium Pickups (3/4 ton)	21		82
Small Pickups (1/2 ton)	74		80
Mule and Wagon	1		?

The trees are felled, limbed, topped, and bucked into 5.5 feet lengths. Approximately one-third of the operations employ small farm tractors for skidding the trees to a landing. These firms work through a dealer network. The dealers usually provide insurance, withhold taxes, provide timber procurement services, marking service, and often provide financial services. Most of the timber is loaded by the dealers on rail cars and shipped to pulp mills in Arkansas and Texas.

Most of the timber in southeast Oklahoma is harvested by tree-length merchandising systems. These systems are popular because they are flexible enough to harvest and transport all the various sizes and species of timber on a given tract of land. The systems often sort or merchandize the various products: pine sawtimber, pine pulpwood, hardwood sawtimber, and hardwood pulpwood, at the landing. The various products are then trucked to the primary producers. This is often the most efficient and economical method of harvesting diverse stands.

The capital versus labor mix of the tree-length merchandising systems depends on many factors and how the system managers forecast these factors. Managers who expect to harvest relatively large volumes of small diameter material often employ feller-bunchers and delimbing gates in addition to chainsaws for the felling operation. These managers would also favor medium or large grapple skidders to operate efficiently with the feller-bunchers. Managers who forecast operating in relatively large diameter timber or who expect to operate on difficult terrain usually favor chainsaw and cable skidders. For instance, chainsaws and cable skidders are preferred by firms operating in the mountainous regions of Leflore, Latimer, northern McCurtain, and Pushmataha counties. Almost all of the tree-length merchandising

systems employ knuckleboom hydraulic loaders and diesel-powered trucks with pole trailers. Only a few of the largest firms employ dozers or other roadbuilding equipment. Most firms find that the rudimentary dozer blades on their skidders suffice for their roadbuilding needs. Firms usually have some type of lowboy for equipment transportation. Each firm has at least one, sometimes two or three, service pickup trucks to transport parts, lubricants, fuels, tools, and crew (Table VIII).

The size and degree of mechanization of the tree-length merchandising systems is also affected by the expected average tract size because the tract size determines expected moving costs. Economies of scale advantages cannot be exploited if the expected average tract size is relatively small. The firms in southeast Oklahoma range in size from those owning 1 skidder to some owning as many as 10 skidders.

The harvesting system composition is also affected by the manager's expectations of downtime due to such factors as weather or mill quotas or block-outs. Because the more efficient highly mechanized systems incur high fixed costs, managers resist their adoption if they fear substantial periods of downtime. Capital investment in tree-length merchandizing systems varies from $200,000 to $2,000,000.

Highly mechanized pulpwood systems are increasing rapidly in number in southeast Oklahoma as thousands of acres of pine plantations are approaching first-thinning age. These systems generally consist of one or two rubber-tired feller-bunchers, two or three medium grapple skidders, a delimbing gate, a knuckleboom hydraulic loader, and two to four diesel-powered trucks with pole trailers. A couple of larger firms have adopted mechanical delimbers. These systems are capital intensive and

very efficient. Capital investment is usually approximately $500.000.

The whole-tree chip system is probably the most capital intensive system in use in Oklahoma. Currently, there are only two firms employing the system, and only one was operating at the time of the survey. The one system operating employed two feller-bunchers, three medium grapple skidders, one 750 horsepower portable chipper, and five to six diesel-powered trucks and chip vans. This system harvests trees that are unusable for traditional roundwood products. The trees, including branches, bark, and foliage, are chipped and blown directly into the chip vans. A local pulp mill burns the chips to produce steam to generate power for the mill. Capital investment would be approximately $1.5 million.

Using the Appendixes

The Appendixes contain detailed breakdowns of shipments, employment costs, and equipment costs for each region. This information should be useful to harvesting operation managers, foremen, or owners.

A forest harvesting manager seeking fixed or operating expenses for new machinery should consult Appendix A compiled by Werblow and Cubbage (1986), or calculate the cost according to Miyata (1980). Although Werblow and Cubbage's figures are convenient to use, it would be wise to calculate individual equipment costs according to Miyata. Certain assumptions made by Werblow and Cubbage may not still be valid. For instance, they assumed a 15 percent interest charge when the study was conducted in 1984. Present interest rates are somewhat lower. Also, the fuel prices used by Werblow and Cubbage are approximately 30 percent higher than current prices. However, insurance rates are as much as 30

percent higher currently than when their report was compiled. Werblow and Cubbage's figures should serve only as broad guidelines and not as substitutes for individual calculations of machine operating expense. The procedures described by Miyata (1980) for calculating equipment operating costs should be applicable to most harvesting situations, including Oklahoma, and the procedures are affected little by the passage of time.

Appendix D contains 1985 employment, payroll, and labor costs for each region by job description. It is interesting to note that wages are significantly higher in the southeast region of Oklahoma and Arkansas and Texas. These are also the regions employing the most modern capital intensive harvesting systems. This strongly suggests that wage rates are a function of equipment and system productivity. Therefore, it seems reasonable to assume that the introduction of more advanced harvesting systems to the less developed regions will result in a dramatic increase in wage rates and consequently, economic well-being.

It should be noted that workmen's compensation expenses for 1985 were staggering. The average workmen's compensation rate for the industry was an incredible 36 percent of payroll.

Workmen compensation rates have historically been high for the forest harvesting industry. Most other states with forest harvesting industries are also experiencing very high rates. It is not a phenomenon restricted to Oklahoma. The forest harvesting industry is not the only industry experiencing seemly excessive rates (Insurance Costs Spiral Higher, 1985). Other industries considered "high risk", such as roofing and steel erection, are faced with high rates. The problem of high rates is complicated by the fact that workmen compensation programs

are administered on a state basis, usually by individual state insurance commissions. Each state has different methods and procedures for rate calculation and claim payment. Many factors enter into rate determination: the frequency and severity of accidents for the industry, the number of accidents of the individual firm, and the size of the claim amounts awarded are the most important.

Two aspects of the problem need to be addressed. First, the forest harvesting industry needs to reduce its high risk image by dramatically reducing preventable injuries. Within the last 5 to 10 years the larger forest product firms have instituted programs to educate, encourage, and require harvesting contractors to adopt basic safety equipment such as hard hats, saw chaps, eye and ear protection, and safety boots. These efforts have proven effective. In states like Oklahoma, however, where there are many small independent contractors, these safety incentives may need to be implemented by state and local agencies in order to reach all firms. The most effective approach is to demonstrate to harvesting managers and owners how dramatically claims are reduced if employees are required to use proper safety equipment. Obviously, the reduced injuries increase productivity as well as lowering labor expense.

The second aspect of the problem is to somehow slow the rate of increase in workmen compensation rates. This is a problem facing all industries, not just forest harvesting. This is an indication that the entire system may need re-evaluation at the state level.

Certainly, rising health costs necessitate increasing rates. However, from January to November, 1985, the base workmen's compensation rate charged new forest harvesting firms in Oklahoma rose from $25.63 per $100.00 of payroll to $36.01, an increase of 29 percent. Health

costs could not have risen that dramatically during the same time period. Obviously, rapidly escalating benefit payments are the primary reason for the rapid rate increases (U.S. Bureau of the Census, 1986).

How can benefit payments be reduced? Of course steps should be taken to continue to reduce avoidable accidents and to make the work place safer. However, major changes in the system may also need to be considered. Stricter guidelines for benefit awards may be necessary. Insurance companies have demonstrated that establishing strict payment rates for routine surgical procedures have lowered hospitalization expenses without significantly impairing service. Florida has passed workmen compensation reform and has seen encouraging results. The legislation included provision for hearing boards to hear and settle claims without costly litigation or legal counsel. Louisiana tried but failed to pass similar legislation. This is an issue that goes far beyond the forest harvesting industry. The Oklahoma economy could possibly benefit from similar reforms.

Appendix E contains 1985 average stumpage and delivered prices for shipments for each region. It also details shipment amounts reported for each region for 1983, 1984, and 1985.

Appendix F contains detailed fixed and operating expenses for the different types of equipment employed in each region. This information gives a good estimation of current cost per hour or mile for the various harvesting equipment.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The Oklahoma forest harvesting industry is a diverse industry, primarily due to the diverse timber types found throughout the state and the forest product markets associated with these timber types. The size and availability of markets for forest products seem to have a profound effect on the harvesting industry. In regions of the state where the products markets are weak and volatile, such as the northeast and western regions, the harvesting industry is characterized by antiquated equipment and low paying jobs. Unpredictable markets force managers to keep fixed costs, and consequently capital investments, at a minimum. Southeast Oklahoma, which benefits from stronger, more stable product markets, has a harvesting industry characterized by relatively modern equipment and competitive wages. The forest harvesting industry is very important to the economy of Southeast Oaklahoma. The industry, as a whole, is relatively inefficient when compared with forest harvesting industries in other states and other Oklahoma manufacturers and producers.

Conclusions

The Oklahoma forest harvesting industry employed 1,128 people in 1985, payroll was $10,638,138, value of shipments was $45,985,100, cost

of materials was $31,817,883, value added by manufacture was $14,167,217, net income was minus $5,066,093, and return on income was minus 11 percent. Detailed information on shipment amounts and prices, labor wage rates and costs, and fixed operating equipment costs are compiled in the Appendixes.

Two possible explanations for the apparent losses are presented. The first hypothesis is that the hardwood sawtimber harvesting industry to a large extent, especially in the northeast and west, operates as a cost center of the hardwood sawmills. The second hypothesis is that rapidly dropping prices for shipments in 1985 caused substantial losses. The rapidly dropping prices may have been the result of the severe pine beetle infestations in the South during 1985, flooding the market with salvage timber.

Recommendations

The Oklahoma forest harvesting industry's future depends on the markets for the products it produces and raw material availability. Growth currently exceeds harvests in Oklahoma. New markets need to be developed to better utilize the forest resource. Improved management and planning by primary forest producers in existing markets are needed to instill the confidence necessary to encourage harvesting managers to invest in new forest harvesting technology as it is developed. Longer term contracts guaranteeing stable production for long periods of time are needed to extend the forest harvesting manager's planning horizon so that he can make more confident capital investment plans. These steps will in turn improve the industry's efficiency and productivity, and consequently, wage rates. This is a goal the Oklahoma forest industry

can adopt immediately.

This study raises some interesting questions that deserve further investigation. Are the two hypotheses presented to explain the industry loss valid? What measures can be taken to create new markets and improve existing markets, and who should implement these measures? Work could be done to create or adapt a harvesting system simulator valid for use in Oklahoma. The data collected by this study would support examination of the relationship, at the individual operator level, of input efficiency and capital structure. An examination could also be made, at the individual operator level, to determine if a significant relationship exists between the various industry inputs and value added by manufacture.

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APPENDIXES

APPENDIX A

AVERAGE MACHINE RATES FOR FOREST HARVESTING EQUIPMENT

TABLE IX

AVERAGE MACHINE RATES FOR FOREST HARVESTING EQUIPMENT, 1984

Equipment	Delivered price	Salvage value	Ownership period (yr)	Estimated usage per yr (hr/mi)	Cost per operating hr					
					Fixed	Operating				
						Fuel & lubricant	Maintenance & repair	Tire/ track	Total operating	Total
Chainsaw—straight blade	$ 550	$ 0	1	1200	$ 0.53	$ —	$ —	$ —	$ 3.50	$ 4.03
Feller bunchers										
Three-wheeled	52,000	13,000	3	1300	16.30	2.18	3.04	1.32	6.54	22.84
Sm. rubber-tired, 65–82 hp	75,000	18,750	3	1300	23.51	4.01	6.07	.66	10.74	34.25
Med. rubber-tired, 83–100 hp	85,000	21,250	4	1300	22.25	4.18	6.13	.66	10.97	33.22
Lg. rubber-tired, 110–130 hp	109,500	27,375	4	1300	28.66	6.53	7.90	1.42	15.85	44.51
Limited area tracked	188,200	47,050	5	1300	41.99	6.95	6.90	8.50	22.35	64.34
Cable skidders										
70–80 hp	50,700	12,675	4	1300	13.46	3.43	4.09	.69	8.21	21.67
80–100 hp	60,100	15,025	4	1300	15.96	4.16	4.58	.73	9.47	25.43
100–120 hp	68,000	17,000	5	1200	17.28	5.32	5.01	1.15	11.48	28.76
120–140 hp	72,500	18,125	5	1200	18.42	5.61	5.71	1.14	12.46	30.88
140+ hp	98,700	24,675	5	1200	25.09	7.15	7.22	1.93	16.30	41.39
Grapple skidders										
70–90 hp	70,500	17,625	4	1300	18.73	38.3	5.76	.69	10.28	29.01
110–130 hp	89,200	22,300	5	1200	22.68	5.83	6.20	1.14	13.17	35.85
130+ hp	115,800	28,950	5	1200	29.44	7.55	8.25	1.92	17.72	47.16
Other skidders										
Tracked cable skidder	115,000	28,750	5	1200	29.23	5.80	9.03	1.60	16.43	45.65
Clambunk skidder	225,000	56,250	5	1200	57.20	8.43	16.88	2.30	27.61	84.81
Farm tractor skidder	36,300	9,075	5	1000	11.08	4.23	2.80	.72	7.75	18.83
Forwarders										
80–100 hp shortwood forwarder	63,500	15,875	4	1300	16.87	4.32	5.25	1.03	10.60	27.47
120–130 hp longwood forwarder	75,700	18,925	4	1300	20.11	5.39	6.70	1.03	13.12	33.23
Slasher/delimber										
Sm. hyd. slasher—chain	11,500	0	4	1300	3.17	—	—	—	1.16	4.33
16" Iron gate delimber	2,400	0	5	1500	.46	—	—	—	.15	.61
Loaders										
Bigstick cable loader	3,700	0	5	720	1.49	—	—	—	2.50	3.99
Sm. hyd. knuckleboom (9,000–15,000 lb max lift)	27,300	6,825	5	1000	7.38	3.05	8.40	—	11.45	18.83
Med. hyd. knuckleboom (15,000–23,000 lb max lift)	60,000	15,000	5	1000	16.20	3.49	9.42	—	12.91	29.11
Lg. hyd. knuckleboom (23,000–33,000 lb max lift)	83,000	20,825	5	1000	22.50	4.94	12.50	—	17.44	39.94
Trailer to mount loader	4,500	1,125	5	1000	1.22	—	—	—	.60	1.82
Whole-tree chippers										
Med. W-T chipper (18"–20", 300–400 hp)	137,200	34,300	5	1500	25.15	13.71	10.75	.40	24.86	50.01
Lg. W-T chipper (20"–23", 500+ hp)	229,000	57,250	5	1500	41.98	23.48	15.70	.40	39.58	81.56

IX (Continued)

Equipment	Delivered price	Salvage value	Ownership period (yr)	Estimated usage per yr (hr/mi)	Cost per operating hr					
						Operating				
					Fixed	Fuel & lubricant	Maintenance & repair	Tire/ track	Total operating	Total
Road work equipment										
Small tracked dozer—80 hp	60,800	15,200	5	1200	13.93	4.23	4.04	3.33	11.60	25.53
Med. tracked dozer—140 hp	125,500	31,375	5	1200	28.76	7.29	7.76	5.58	20.63	49.39
Road grader—135 hp	116,400	29,100	8	1250	19.27	6.55	5.57	.95	13.07	32.34
Trucks										
Dead tandem bobtail	19,500	4,875	3	24,000	.41	.28	.25	.08	.61	1.02
Live tandem bobtail	27,500	6,875	4	24,000	.48	.32	.26	.08	.66	1.14
Diesel truck—tractor	70,000	17,500	5	60,000	.43	.23	.21	.07	.51	.94
½-ton pickup	9,000	2,250	3	25,000	.16	.09	.04	.01	.14	.30
1-ton service/crew truck	30,000	7,500	3	25,000	.50	.13	.11	.02	.26	.76
Trailers										
Shortwood	11,000	2,750	8	50,000	.05	—	—	—	.07	.12
Double-deck log	10,500	2,625	8	50,000	.04	—	—	—	.07	.11
Pole	10,000	2,500	8	50,000	.04	—	—	—	.07	.11
Chip van	19,000	4,750	8	37,500	.10	—	—	—	.09	.19
25-ton lowboy	14,000	3,500	10	10,000	.26	—	—	—	.07	.33

Source: D.A. Werblow, and F.W. Cubbage, "Forest Harvesting Equipment Ownership and Operating Costs in 1984," Southern Journal of Applied Forestry, 10,1 (1986), 10-15.

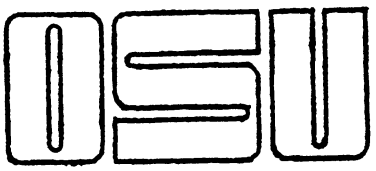
APPENDIX B

PRIMARY QUESTIONNAIRE

No. ____

Timber Harvesting Study
Department of Forestry
Oklahoma State University
Stillwater, OK 74078

(back)



OKLAHOMA FOREST HARVESTING

INDUSTRY STUDY

Research conducted by the
Department of Forestry

OKLAHOMA STATE UNIVERSITY

Stillwater, Oklahoma

To the participant:

To assess and possibly enhance the harvesting industry's impact on Oklahoma's economy, your help is needed to describe and analyze its current condition.

Your help in answering these questions will allow us to draw a composite picture of the industry, upon which future researchers and policy makers can draw. This study will also generate information which should be directly useful to you.

When you have completed the survey, please seal and drop it in the nearest mailbox; we have already provided postage. If you are interested in copies of the results, just check the blank below and we will gladly provide you with a summary when we have compiled the responses.

Thank you for your cooperation.

Please send me a copy of the results of this survey.___

(cover)

OKLAHOMA HARVESTING INDUSTRY
SURVEY

1. Are you currently harvesting timber in Oklahoma? (Please circle one) yes no

2. If you answered no to Q-1, do you intend to resume timber harvesting in Oklahoma within the next year? (Please circle one)
   yes no

   If you answered no to Q-2 please stop here and return the survey.

3. Please specify below the equipment that comprises your current harvesting operation. (Please fill out a separate line for each different make and model)

	MAKE and MODEL	YEAR	QUANTITY
DIRECTIONAL SHEARS			
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
FELLER BUNCHERS			
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
CABLE SKIDDERS			
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___

	MAKE and MODEL	YEAR	QUAN-TITY
GRAPPLE SKIDDERS			
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
FORWARDERS			
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
LOADERS			
	_____	___	___
	_____	___	___
TRUCKS (for hauling)			
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
TRAILERS (for hauling)			
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___
ON-SITE CHIPPERS			
	_____	___	___
	_____	___	___

	MAKE and MODEL	YEAR	QUAN-TITY
DOZERS			
	_____	___	___
	_____	___	___
LOWBOYS			
	_____	___	___
	_____	___	___
SUPPORT VEHICLES (pickups, crew truck, etc.)	_____	___	___
	_____	___	___
	_____	___	___
	_____	___	___

4. How many chainsaws does your operation own? _____.

5. Do you employ contract trucking? (Please circle one) yes no

6. If you answered yes to Q-5, what percentage of your trucking is contracted? (Please circle one)

   20% 40% 60% 80% 100%

7. What is the average haul distance (in miles) for your operations, from the woods to the mill? _____.

8. Please fill in the shipment information below for the products you normally produce from Oklahoma. (If the volume is in thousand board feet, please circle M; if it is in cords, please circle C; if it is in tons,please circle T.)

	VOLUME 1983	VOLUME 1984	VOLUME 1985	
PINE SAWLOGS	_____	_____	_____	M C T

	VOLUME 1983	VOLUME 1984	VOLUME 1985	
HARDWOOD SAWLOGS	_____	_____	_____	M C T
PINE PULPWOOD	_____	_____	_____	M C T
HARDWOOD PULPWOOD	_____	_____	_____	M C T
PINE VENEER (plywood)	_____	_____	_____	M C T
HARDWOOD VENEER	_____	_____	_____	M C T
POLES/ PILING	_____	_____	_____	M C T
ON-SITE CHIPS for fuel	_____	_____	_____	M C T
for pine pulp	_____	_____	_____	M C T
for hard-wood pulp	_____	_____	_____	M C T
FENCE POSTS	_____	_____	_____	M C T
FIREWOOD	_____	_____	_____	M C T

9. What percentage of your total production is actually cut in Oklahoma? (Please circle one)

   20% 40% 60% 80% 100%(all)

10. What percentage of your Oklahoma production do you purchase, as opposed to contract logging? (Please circle one)

    20% 40% 60% 80% 100%(all)

11. Approximately how many days per year does your firm work? _____.

12. Please fill in the employee information below. (If some employees do more than one job, please list them under their primary job only; Please be sure and indicate the basis for payment, i.e. per year, per hour, per ton, etc.)

	HOW MANY	SALARY per YEAR, WAGE RATE per HOUR, or SALARY per UNIT of PRODUCTION	AVERAGE HOURS WORKED per WEEK
CHAINSAW OPERATORS	___	_____	____
SHEAR or FELLER-BUNCHER OPERATORS	___	_____	____
SKIDDER or FORWARDER OPERATORS	___	_____	____
LOADER OPERATORS	___	_____	____
TRUCK DRIVERS	___	_____	____

	HOW MANY	SALARY per YEAR, WAGE RATE per HOUR, or SALARY per UNIT of PRODUCTION	AVERAGE HOURS WORKED per WEEK
CHIPPER OPERATORS	___	_____	____
DOZER OPERATORS	___	_____	____
MANAGERIAL	___	_____	____
ADMINISTATIVE (secretaries, etc.)	___	_____	____
CRUISERS/ SCALERS	___	_____	____
MECHANICS	___	_____	____

13. Please circle the following factors that cause frequent downtime for your organization.(you may circle more than one)
    1. weather
    2. mechanical failure
    3. quotas or mill blockouts
    4. labor problems
    5. other(please specify)

    _____.

14. Do you have an office specifically for your business? (Please circle one) yes no

15. If you answered yes to Q-14, what is the approximate square footage of your office? _____.

16. Do you have a repair shop specifically for your business? (Please circle one) yes no

17. If you answered yes to Q-16, what is the approximate square footage of your repair shop? _____.

18. Do you have operating expense records? (e.g. insurance, taxes, interest, depreciation, repairs, maintenance, fuel, etc.) (Please circle one) yes no

19. If you answered yes to Q-18, would you be willing to share this data? (The data will be seen by persons involved with this study only; data will be destroyed upon completion of analysis.) (Please circle one) yes no

20. If you answered yes to Q-19, please indicate the phone number at which we could reach you and the best time for us to call. (remember any data provided would be strictly confidential)

    PHONE NUMBER _____.
    TIME _____.

21. In case we need to contact you to clarify answers you may have given, would you put your current name, phone number, and address below? (this is optional, if you don't want to give this information, leave the question blank)

    NAME _____.
    ADDRESS _____.
    CITY _____.
    STATE _____.
    PHONE NUMBER ( ) _____.

Please use the additional space on the next page for any comments you may have.

THANK YOU!

Please feel free to include your ideas or comments in the following space:

APPENDIX C

EXPENSE QUESTIONNAIRE

OKLAHOMA FOREST HARVESTING INDUSTRY STUDY

Expense Information

Q-1. What is your Workman Compensation expense? (please include basis for payment, i.e. per ton, per $100, per year, etc.)

Current Workman Compensation Rate. _____

Workman Compenation Expense for 1985. Rate,_____ Total,_____

Q-2. What was your business Social Security expense for 1985? _____.

Q-3. What was your total unemployment insurance expense for 1985? _____.

Q-4. Please list current yearly license expenses for over-the-road trucks and trailers.

Trucks for Hauling. _____.
Trailers for Hauling. _____.
Service or Crew Trucks _____.
Lowboy _____.
Other _____ _____.
_____ _____.
_____ _____.

Q-5. Please list total road use taxes paid for 1985.

_____.

Q-6. Please list any special permit expenses for 1985. (i.e. over-width, over-length, over-weight, etc.)

TYPE EXPENSE	AMOUNT
_____	_____
_____	_____
_____	_____

Q-7. List any other taxes or insurance expenses for 1985.

TYPE EXPENSE	AMOUNT
_____	_____
_____	_____

Q-8. What was your interest expense for 1985? _____.

Q-9. Please list the operating and insurance expenses for your equipment for 1985.

EQUIPMENT	FUEL			MOTOR OIL		HYDRAULIC OIL		TIRE/ TRACK	REPAIR COST	MAINT. COST	EQUIPMENT INSURANCE		
	(#Gal.	Cost/ Gal.	Total Cost)	(#Qts.	Total Cost)	(#Gal.	Total Cost)	Total (Cost)	Total (Cost)	Total (Cost)	(Rate	Total Amount	Number Machines)
CHAINSAWS	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
SHEARS or FELLER-BUNCHERS	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
SKIDDERS or FORWARDERS	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
LOADERS	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
TRUCKS/TRAILERS (for hauling)	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
DOZERS	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
CHIPPERS	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
SERVICE or CREW TRUCKS	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
OTHER													
_____	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
_____	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____
_____	____	____	_____	____	_____	____	_____	_____	_____	_____	____	_____	____

APPENDIX D

EMPLOYMENT, PAYROLL, AND LABOR COSTS

TABLE X

EMPLOYMENT, PAYROLL, AND LABOR COSTS BY REGION*

Region	Payroll	Labor Cost
Arkansas	$ 375,636	$ 543,462
Kansas	27,720	40,347
Missouri	120,256	175,202
Northeast Oklahoma	229,913	338,579
Southeast Oklahoma	7,494.561	10,877,054
West Oklahoma	162,255	240,296
Texas	138,794	201,353
Total (questionnaire)	$ 8,549,135	$12,416,293
shortwood and post markets (estimate)	2,089,000	2,494,000
Total	$10,638,135	$14,910,293

*all figures adjusted to reflect Oklahoma share of production.

TABLE XI

ARKANSAS EMPLOYMENT AND PAYROLL

Job Description	Number Employees	Average Daily Wage	Average Number Days	Yearly Payroll
Chainsaw Op.	21	$76.50	230	$369,495
Skidder Op.	14	80.75	230	260,015
Loader Op.	1	50.00	230	11,500
Truck Op.	17	68.00	230	265,880
Managers	1	50.00	230	11,500
Administrative	2	45.00	230	20,700
Total	56			$939,090
Percent Work in Oklahoma				x .40
Total Oklahoma Share				$375,636

TABLE XII

ARKANSAS LABOR COSTS

Job Description	Yearly Payroll	Social Security	Federal and State Unemp.	Workmen's Compensation	Labor Cost
Chainsaw Op.	$369,495	$26,049	$5,733	$133,018	$ 534,295
Skidder Op.	260,015	18,331	3,822	93,605	375,773
Loader Op.	11,500	811	273	4,140	16,724
Truck Op.	265,880	18,745	4,641	95,717	384,983
Managers	11,500	811	273	4,140	16,724
Administrative	20,700	1,459	546	7,452	30,157
Total	$939,090				$1,358,656
Percent Work in Oklahoma	x .40				x .40
Total Oklahoma Share	$375,636				$ 543,462

TABLE XIII

KANSAS EMPLOYMENT AND PAYROLL

Job Description	Number Employees	Average Daily Wage	Average Number Days	Yearly Payroll
Chainsaw Op.	4	$73	225	$ 65,700
Skidder Op.	1	68	225	15,300
Truck Op.	4	64	225	57,600
Total				$138,600
Percent Work in Oklahoma				x .20
Total Oklahoma Share				$ 27,720

TABLE XIV

KANSAS LABOR COSTS

Job Description	Yearly Payroll	Social Security	Federal and State Unemp.	Workmen's Compensation	Labor Cost
Chainsaw Op.	$ 65,700	$4,632	$1,540	$23,652	$ 95,524
Skidder Op.	15,300	1,079	385	5,508	22,272
Truck Op.	57,600	4,061	1,540	20,736	83,937
Total	$138,600				$ 201,733
Percent Work in Oklahoma	x .20				x .20
Total Oklahoma Share	$ 27,720				$ 40,347

TABLE XV

MISSOURI EMPLOYMENT AND PAYROLL

Job Description	Number Employees	Average Daily Wage	Average Number Days	Yearly Payroll
Chainsaw Op.	12	$ 57	225	$153,900
Skidder Op.	7	54	225	85,050
Loader Op.	2	60	225	27,000
Truck Op.	11	51	225	126,225
Manager	1	100	225	22,500
Total	33			$414,675
Percent Work in Oklahoma				x .29
Total Oklahoma share				$120,256

TABLE XVI

MISSOURI LABOR COSTS

Job Description	Yearly Payroll	Social Security	Federal and State Unemp.	Workmen's Compensation	Labor Cost
Chainsaw Op.	$153,900	$10,850	$3,982	$55,404	$ 224,136
Skidder Op.	85,050	5,996	2,323	30,618	123,987
Loader Op.	27,000	1,904	664	9,720	39,288
Truck Op.	126,225	8,899	3,650	45,441	184,215
Manager	22,500	1,586	332	8,100	32,518
Total	$414,675				$ 604,144
Percent Work in Oklahoma	x .29				x .29
Total Oklahoma Share	$120,256				$ 175,202

TABLE XVII

NORTHEAST OKLAHOMA EMPLOYMENT AND PAYROLL

Job Description	Number Employees	Average Daily Wage	Average Number Days	Yearly Payroll
Chainsaw Op.	15	$30	166	$ 74,700
Skidder Op.	4	28	166	18,592
Loader Op.	4	40	166	26,560
Truck Op.	16	50	166	132,800
Total	39			$252,652
Percent Work in Oklahoma				x .91
Total Oklahoma Share				$229,913

TABLE XVIII

NORTHEAST OKLAHOMA LABOR COSTS

Job Description	Yearly Payroll	Social Security	Federal and State Unemp.	Workmen's Compensation	Labor Cost
Chainsaw Op.	$ 74,700	$5,266	$4,095	$26,892	$ 110,953
Skidder Op.	18,592	1,311	1,092	6,693	27,688
Loader Op.	26,560	1,872	1,092	9,562	39,086
Truck Op.	132,800	9,362	4,368	47,808	194,338
Total	$252,652				$ 372,065
Percent Work in Oklahoma	x .91				x .91
Total Oklahoma Share	$229,913				$ 338,579

TABLE XIX

SOUTHEAST OKLAHOMA EMPLOYMENT AND PAYROLL

Job Description	Number Employees	Average Daily Wage	Average Number Days	Yearly Payroll
Chainsaw Op.	150	$ 79	230	$2,725,500
Feller-Buncher Op.	13	80	230	239,200
Skidder Op.	124	70	230	1,996,400
Loader Op.	18	73	230	302,220
Truck Op.	166	68	230	2,596,240
Foresters	2	80	230	36,800
Dozer Op.	6	72	230	99,360
Chipper Op.	2	96	230	44,160
Managers	8	101	230	185,840
Mechanics	4	76	230	65,920
Administrative	5	31	230	35,650
Total	498			$8,327,290
Percent Work in Oklahoma				x .90
Total Oklahoma Share				$7,494,561

TABLE XX

SOUTHEAST OKLAHOMA LABOR COSTS

Job Description	Yearly Payroll	Social Security	Federal and State Unemp.	Workmen's Compensation	Labor Cost
Chainsaw Op.	$2,725,500	$204,413	$40,950	$981,180	3,952,043
Feller-Buncher Op.	239,200	17,940	3,549	86,112	346,801
Skidder Op.	1,996,400	149,730	33,852	718,704	2,898,686
Loader Op.	302,220	22,667	4,914	108,799	438,600
Truck Op.	2,596,240	194,718	45,318	934,646	3,770,922
Foresters	36,800	2,760	546	13,248	53,354
Dozer Op.	99,360	7,452	1,638	35,770	144,220
Chipper Op.	44,160	3,312	546	15,898	63,916
Managers	185,840	13,938	2,184	66,902	268,864
Mechanics	65,920	4,944	1,092	23,731	95,687
Administrative	35,650	2,674	1,365	12,834	52,523
Total	$8,327,290				$12,085,616
Percent Work In Oklahoma	x .90				x .90
Total Oklahoma Share	$7,494,561				$10,877,054

TABLE XXI

TEXAS EMPLOYMENT AND PAYROLL

Job Description	Number Employees	Average Daily Wage	Average Number Days	Yearly Payroll
Chainsaw Op.	9	$ 70	237	$149,310
Feller-Buncher Op.	2	80	237	37,920
Skidder Op.	7	70	237	116,130
Truck Op.	8	50	237	94,800
Dozer Op.	2	72	237	34,128
Manager	2	100	237	47,400
Mechanic	1	75	237	17,775
Administrative	2	35	237	16,590
Total	33			$514,053
Percent Work in Oklahoma				x .27
Total Oklahoma Share				$138,794

TABLE XXII

TEXAS LABOR COSTS

Job Description	Yearly Payroll	Social Security	Federal and State Unemp.	Workmen's Compensation	Labor Cost
Chainsaw Op.	149,310	$11,198	$2,205	$53,751	$ 216,464
Feller-Buncher Op.	37,920	2,844	490	13,651	54,905
Skidder Op.	116,130	8,710	1,715	41,807	168,362
Truck Op.	94,800	7,110	1,960	34,128	137,998
Dozer Op.	34,128	2,560	490	12,286	49,464
Manager	47,400	3,555	490	17,064	68,509
Mechanic	17,775	1,333	245	6,399	25,752
Administrative	16,590	1,244	490	5,972	24,296
Total	$514,053				$ 745,750
Percent Work in Oklahoma	x .27				x .27
Total Oklahoma Share	$138,794				$ 201,353

TABLE XXIII

WEST OKLAHOMA EMPLOYMENT AND PAYROLL

Job Description	Number Employees	Average Daily Wage	Average Number Days	Yearly Payroll
Chainsaw Op.	13	$43	145	$ 81,055
Skidder Op.	5	40	145	29,000
Truck Op.	12	30	145	52,200
Total	30			$162,255
Percent Work in Oklahoma				x 1.00
Total Oklahoma Share				$162,255

TABLE XXIV

WEST OKLAHOMA LABOR COSTS

Job Description	Yearly Payroll	Social Security	Federal and State Unemp.	Workmen's Compensation	Labor Cost
Chainsaw Op.	$ 81,055	$5,714	$3,549	$29,180	$ 119,498
Skidder Op.	29,000	2,045	1,365	10,440	42,850
Truck Op.	52,200	3,680	3,276	18,792	77,948
Total	$162,255				$ 240,296
Percent Work in Okla.	x 1.00				x 1.00
Total Okla. Share	$162,255				$ 240,296

APPENDIX E

SHIPMENTS

TABLE XXV

TOTAL VALUE OF SHIPMENTS BY REGION--1985

Region	Stumpage	Delivered
Arkansas	$ 2,055,600	$ 3,220,500
Kansas	117,100	209,700
Missouri	89,800	172,200
Northeast Oklahoma	221,200	469,500
West Oklahoma	51,100	115,200
Southeast Oklahoma	18,751,500	36,853,200
Texas	185,800	349,300
Short pulpwood and post markets	1,141,000	4,595,500
Total	$22,613,100	$45,985,100

TABLE XXVI

ARKANSAS SHIPMENTS
(Weight-Thousand tons)
(Prices, per ton basis)
(Shipment values in thousands of dollars)

Product	1983	1984	1985	1985 Prices		1985 Shipment Value	
				Stump.	Del.	Stump.	Del.
Pine sawtimber	87.6	87.9	107.6	$18.2	$27.2	$1,958.3	$2,926.7
Hardwood sawtimber	13.6	13.6	13.6	5.7	16.6	77.5	225.8
Pine pulpwood (longwood)	2.7	2.7	3.8	5.2	17.9	19.8	68.0
Totals						$2,055.6	$3,220.5

TABLE XXVII

KANSAS SHIPMENTS
(Weight--thousand tons)
(prices, per ton basis)
(Shipment values in thousands of dollars)

Product	1983	1984	1985	1985 Prices		1985 Shipment Value	
				Stump.	Del.	Stump.	Del.
Hardwood Sawtimber	8.5	6.8	3.6	$ 5.3	$ 14.7	$ 19.1	$ 52.9
Hardwood Veneer	5.8	1.7	1.2	81.7	$130.7	98.0	156.8
Totals						$117.1	$209.7

TABLE XXVIII

MISSOURI SHIPMENTS
(Weight--thousand tons)
(Prices, per ton basis)
(Shipment value in thousands of dollars)

Product	1983	1984	1985	1985 Prices		1985 Shipment Value	
				Stump.	Del.	Stump.	Del.
Hardwood Sawtimber	5.7	5.6	4.6	$ 5.3	$ 14.7	$24.4	$ 67.6
Hardwood Veneer	2.7	.5	.8	81.7	130.7	65.4	104.6
Totals						$89.8	$172.2

TABLE XXIX

NORTHEAST OKLAHOMA SHIPMENTS
(Weight--thousand tons
(Prices, per ton basis)
(Shipment value in thousands of dollars)

Product	1983	1984	1985	1985 Prices		1985 Shipment Value	
				Stump.	Del.	Stump.	Del.
Hardwood Sawtimber	18.3	17.1	18.6	$ 5.3	$ 14.7	$ 98.6	$273.4
Hardwood Veneer	1.0	1.0	1.5	81.7	130.7	122.6	196.1
Totals						$221.2	$469.5

TABLE XXX

WEST OKLAHOMA SHIPMENTS
(Weight--thousand tons)
(Prices, per ton basis)
(Shipment value in thousands of dollars)

Product	1983	1984	1985	1985 Prices		1985 Shipment Value	
				Stump.	Del.	Stump.	Del.
Hardwood Sawtimber	7.8	7.0	6.7	$ 5.2	$ 13.3	$34.8	$ 89.1
Hardwood Veneer	.2	.1	.2	81.7	130.7	16.3	26.1
Totals						$51.1	$115.2

TABLE XXXI

SOUTHEAST OKLAHOMA SHIPMENTS
(Weight--thousand tons)
(Prices, per ton basis)
(Shipment value in thousands of dollars)

Product	1983	1984	1985	1985 Prices (per ton) Stump.	1985 Prices (per ton) Del.	1985 Shipment Value Stump.	1985 Shipment Value Del.
Pine Sawtimber	860.0	936.1	961.5	$16.1	$25.1	$15,480.2	$24,133.7
Hardwood Sawtimber	251.7	270.2	263.3	5.6	14.5	1,474.5	3,817.9
Hardwood Veneer	5.3	5.8	5.8	30.1	79.1	174.6	458.8
Poles/Piling (Pine)	3.3	5.1	8.6	21.3	31.3	183.2	269.2
Pine Pulpwood (longwood)	353.4	325.4	324.4	4.1	17.0	1,330.5	5,516.5
Hardwood Pulpwood (longwood)	55.8	60.0	58.8	.8	10.7	47.0	629.2
Fuel chips	50.0	100.0	122.9	.5	16.5	61.5	2,027.9
Totals						$18,751.5	$36,853.2

TABLE XXXII

TEXAS SHIPMENTS
(Weight--thousand tons)
(Prices, per ton basis)
(Shipment value in thousands of dollars)

Product	1983	1984	1985	1985 Prices		1985 Shipment Value	
				Stump.	Del.	Stump.	Del.
Pine Sawtimber	7.8	7.8	9.8	$15.7	$24.7	$153.9	$242.1
Pine Pulpwood	5.1	5.1	5.1	5.3	17.4	27.0	88.7
Hardwood Sawtimber	.8	.8	.8	5.4	15.8	4.3	12.6
Hardwood Pulpwood	.6	.6	.6	1.0	9.8	.6	5.9
Totals						$185.8	$349.3

TABLE XXXIII

SHORT PULPWOOD AND POST SHIPMENTS
(Weight--thousand tons)
(Prices, per ton basis)

Product	Vol. 1985	Prices 1985		1985 Shipment Value	
		Stump.	Del.	Stump.	Del.
Pine Pulpwood	162.75	$5	$17	$ 813,750	$ 2,766,750
Hardwood Pulpwood	108.50	1	10	108,500	1,085,000
Posts	43.75	5	17	218,750	743,750
Totals				$1,141,000	$ 4,595,500

APPENDIX F

EQUIPMENT COSTS

TABLE XXXIV

EQUIPMENT COSTS BY REGION

Region	Fixed Costs	Operating Costs	Total Costs
Arkansas	$ 123,505	$ 486,365	$ 609,870
Kansas	1,841	10,678	12,519
Missouri	30,130	134,068	164,198
Northeast Oklahoma	42,416	316,342	358,758
Southeast Oklahoma	3,716,492	7,391,288	11,107,780
Texas	118,990	140,198	259,188
West Oklahoma	84,187	225,844	310,031
Totals	$ 4,117,561	$ 8,704,783	$12,822,344
Short Post and Pulpwood Equipment (estimate)			703,436
Total Equipment Cost			$13,527,800

TABLE XXXV

ARKANSAS EQUIPMENT FIXED COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Depre-ciation	Interest	Licenses	Taxes	Insur-ance	Total Fixed Costs
Chainsaws		8	$	$	$	$	$	$
Cable Skidders	'77	13	1.97				.80	2.77
Grapple Skidders	'84	3	9.17	4.6			1.75	15.52
Loaders	'78	10	1.44				.75	2.19
Diesel Tractor-Trucks	'78	18	.04		.01	.01	.08	.14
Medium pickup	.84	2	.05	.03	.002		.02	.10
Small Pickup	'80	7	.03		.002		.01	.04
Pole Trailers	.77	18	.01				.01	.02
Lowboys	'80	4	.03				.01	.04

Total Fixed Cost (Oklahoma share) = $123,505 (40% of total cost is OK share)

TABLE XXXVI

ARKANSAS EQUIPMENT OPERATING COSTS

Equipment	Average Year	Number Machines	Fuels	Lubricants	Repair Maint.	Tire/ Track	Total Operating Costs
Chainsaws		8	$	$	$	$	$ 4.00
Cable Skidders	'77	13	2.11	.21	4.00	3.06	9.38
Grapple Skidders	'84	3	2.29	.23	7.00	3.06	12.58
Loader	'78	10	1.78	.56	2.40		4.74
Diesel Tractor Trucks	'78	18	.21	.35	.21	.04	.81
Medium Pickup	'84	2	.08	.003	.04	.02	.14
Small Pickup	'80	7	.06	.003	.04	.02	.12
Pole Trailers	'77	18				.03	.03
Lowboys	'80	4				.10	.10

Total Operating Cost (Oklahoma share) = $486,365 (40% of total cost is Oklahoma share)

TABLE XXXVII

KANSAS EQUIPMENT FIXED COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Depre-ciation	Interest	Licenses	Taxes	Insur-ance	Total Fixed Costs
Chainsaws		2	$	$	$	$	$	$
Cable Skidders	'80	1	2.35				.67	3.02
Winch Trucks	'53	2	.02					.02
Bobtail Trucks	'67	2	.02				.07	.09
Small Pickups	'72	2	.02				.01	.03

Total Fixed Cost (Oklahoma share) = $1,841 (20% of total cost is Oklahoma share)

TABLE XXXVIII

KANSAS EQUIPMENT OPERATING COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Fuels	Lubricants	Repair Maint.	Tire/ Track	Total Operating Costs
Chainsaws		2	$	$	$	$	4.00
Cable Skidder	'80	1	2.48	.25	4.27	3.06	10.06
Winch Trucks	'53	2	1.95	.04	1.00		2.99
Bobtail Trucks	'67	2	.28	.004	.10	.07	.45
Small Pickups	'72	2	.06	.003	.04	.02	.12

Total Operating Cost (Oklahoma share) = $10,678 (20% of total cost is Oklahoma share)

TABLE XXXIX

MISSOURI EQUIPMENT FIXED COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Depre-ciation	Interest	Licenses	Taxes	Insur-ance	Total Fixed Costs
Chainsaws		7	$	$	$	$	$	$
Cable Skidders	'74	7	.45				.43	.88
Loaders	'77	7	1.35				.75	2.10
Front-end Loader	'66	1	.02					.02
Farm Tractor	'57	1	.02					.02
Bobtail Trucks	'71	2	.02		.01		.07	.10
Gas Tractor-Trucks	'75	7	.03		.01	.01	.07	.12
Diesel Tractor-Trucks	'72	3	.03		.01	.01	.08	.13
Pole Trailers	'73	8					.01	.01
Lowboys	'70	4					.02	.02
Medium Pickup	'66	1					.01	.01
Small Pickups	'79	6	.01				.01	.02

Total Fixed Cost (Oklahoma share) = $30,130 (29% of total cost is Oklahoma share)

TABLE XL

MISSOURI EQUIPMENT OPERATING COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Fuels	Lubricants	Repair Maint.	Tire/ Track	Total Operating Costs
Chainsaws		7	$	$	$	$	$ 4.00
Cable Skidders	'74	7	1.90	.18	1.54	3.06	6.68
Loaders	'77	7	1.78	.56	2.40		4.74
Front-end Loader	'66	1	1.33	.12	1.60	.30	3.35
Farm Tractor	'57	1	1.33	.12	1.60	.30	3.35
Bobtail Trucks	'71	2	.19	.01	.25	.08	.53
Gas Tractor-Trucks	'75	7	.19	.01	.25	.08	.53
Diesel Tractor-Trucks	'72	3	.21	.01	.21	.07	.50
Pole Trailers	'73	8				.03	.03
Lowboys	'70	4				.05	.05
Medium Pickup	'66	1	.06	.003	.04	.01	.11
Small Pickups	'79	6	.06	.003	.04	.01	.11

Total Operating Cost (Oklahoma share) = $134,068 (29% of total cost is Oklahoma share)

TABLE XLI

NORTHEAST OKLAHOMA EQUIPMENT FIXED COSTS

Equipment	Average Year	Number Machines	Depreciation	Interest	Licenses	Taxes	Insurance	Total Fixed Costs
Chainsaws		17	$	$	$	$		$
Cable Skidders	'74	2	.20				.43	.63
Grapple Skidder	'80	1	1.97				1.08	3.05
Dozers	'65	2						
Winch Trucks	'50	8	.01					.01
Front-end Loaders	'70	6	.02					.02
Bobtail Gas Trucks	'67	14	.02		.01		.07	.10
Gas Tractor-Trucks	'63	2	.01		.01	.01	.07	.10
Diesel Tractor-Trucks	'73	2	.03		.01	.01	.08	.13
Pole Trailers	'73	4					.01	.01
Small Pickups	'75	8	.01				.01	.02

Total Fixed Cost (Oklahoma share) = $30,130 (91% of total cost is Oklahoma share)

TABLE XLII

NORTHEAST OKLAHOMA EQUIPMENT OPERATING COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Fuels	Lubricants	Repair Maint.	Tire/ Track	Total Operating Costs
Chainsaws		17	$	$	$	$	$ 4.00
Cable Skidders	'74	2	1.90	.13	1.53	3.06	6.56
Grapple Skidder	'80	1	1.90	.13	2.95	3.06	7.98
Dozers	'65	2	2.70	.13	4.80	3.06	10.63
Winch Trucks	'50	8	1.95	.04	1.00		2.99
Front-end Loaders	'70	6	1.33	.12	1.60	.30	3.35
Bobtail Gas Trucks	'67	14	.19	.01	.25	.08	.53
Gas Tractor-Trucks	'63	2	.19	.01	.25	.08	.53
Diesel Tractor-Trucks	'73	2	.21	.01	.21	.07	.50
Pole Trailers	'73	4				.03	.03
Small Pickups	'75	8	.06	.003	.04	.01	.11

Total Operating Cost (Oklahoma share) = $316,342 (91% of total cost is Oklahoma share)

TABLE XLIII

SOUTHEAST OKLAHOMA EQUIPMENT FIXED COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Depre-ciation	Interest	Licenses	Taxes	Insur-ance	Total Fixed Costs
Chainsaws		81	$	$	$	$	$	$
Feller-Bunchers	'83	18	12.31	6.28			2.15	20.74
Delimbers	'83	4	14.29	9.86			4.67	28.82
Directional Shear	'74	1	1.04				.46	1.50
Cable Skidders	'77	76	2.00				1.17	3.17
Grapple Skidders	'82	54	11.33	5.78			2.00	19.11
Dozers	'71	24	2.10				1.40	3.50
Farm Tractors	'75	19	.20					.02
Front-end Loaders	'77	8	1.60				1.05	2.65
Loaders	'78	61	2.72				1.25	3.97
Chippers	'78	2	4.80				2.67	7.47
Bobtail Trucks	'71	25	.02		.01		.07	.10
Gas Tractor Trucks	'70	10	.02		.01	.01	.08	.11
Diesel Tractor Trucks	'78	139	.04		.01	.01	.08	.14
Pole Trailers	'75	131	.01				.01	.02
Floats	'75	3	.01				.01	.02
Chip Trailers	'77	9	.02				.01	.03
Lowboys	'73	23	.01				.02	.03
Set-out Trailers	'80	8	.02				.01	.03
Large Pickups	'78	23	.03				.01	.04
Medium Pickups	'82	17	.06				.02	.08
Small Pickups	'80	64	.03				.02	.05
Mule and Wagon	(?)	1						

Total Fixed Cost (Oklahoma Share) = $30,130 (90% of total cost is Oklahoma share)

TABLE XLIV

SOUTHEAST OKLAHOMA EQUIPMENT OPERATING COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Fuels	Lubricants	Repair Maint.	Tire/ Track	Total Operating Costs
Chainsaws		81	$	$	$	$	4.00
Feller-Bunchers	'83	18	2.51	.25	6.15	3.06	11.97
Delimbers	'83	4	3.89	.30	7.14	3.06	14.35
Directional Shear	'74	1	1.78	.20	.46	3.06	5.44
Cable Skidders	'77	76	2.18	.27	2.33	3.06	7.84
Grapple Skidders	'82	54	2.73	.34	6.80	3.06	12.93
Dozers	'71	24	3.33	.34	12.80	3.06	19.53
Farm Tractors	'75	19	1.33	.18	1.60	.30	3.41
Front-end Loaders	'77	8	1.78	.23	2.00	3.06	7.07
Loaders	'78	61	2.22	.30	2.16		4.68
Chippers	'78	2	11.10	.97	9.33		21.40
Bobtail Trucks	'71	25	.19	.01	.25	.08	.53
Gas Tractor-Trucks	'70	10	.19	.01	.25	.08	.53
Diesel Tractor-Trucks	'78	139	.21	.01	.21	.04	.47
Pole Trailers	'75	131				.03	.03
Floats	'75	3				.03	.03
Chip Trailers	'77	9				.03	.03
Lowboys	'73	23				.05	.05
Set-out Trailers	'80	8				.03	.03
Large Pickups	'78	23	.06	.003	.04	.02	.12
Medium Pickups	'82	17	.06	.003	.04	.01	.11
Small Pickups	'80	64	.06	.003	.04	.01	.11
Mule and Wagon	(?)	1	.01		.01		.02

Total Operating Cost (Oklahoma Share) = $7,391,288 (90% total cost is Oklahoma share)

TABLE XLV

TEXAS EQUIPMENT FIXED COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Depre-ciation	Interest	Licenses	Taxes	Insur-ance	Total Fixed Costs
Chainsaws		3	$	$	$	$	$	$
Feller-Bunchers	'85	3	12.31	6.28			2.15	20.74
Cable Skidders	'75	2	.45				.43	.88
Grapple Skidders	'83	3	10.00	5.10			1.75	16.85
Farm Tractor	'70	1	.15					.15
Front-end Loader	'67	1	.02					.02
Loaders	'82	5	10.40	5.30			1.65	17.35
Dozers	'77	4	2.78				1.50	4.28
Bobtail Truck	'81	1	.13		.01		.10	.24
Diesel Tractor Trucks	'82	9	.11	.05	.01	.01	.10	.28
Pole Trailers	'77	7	.01				.01	.02
Setout Trailers	'74	3	.01				.01	.02
Lowboy	'86	1	.24				.02	.26
Medium Pickups	'82	2	.06				.02	.08
Small Pickups	'81	3	.03				.02	.05

Total Fixed Cost (Oklahoma share) = $118,990 (27% of total cost is Oklahoma share)

TABLE XLVI

TEXAS EQUIPMENT OPERATING COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Fuels	Lubricants	Repair Maint.	Tire/ Track	Total Operating Costs
Chainsaws		3	$	$	$	$	$ 4.00
Feller-Bunchers	'85	3	2.81	.23	6.15	3.06	12.25
Cable Skidders	'75	2	1.90	.18	1.54	3.06	6.68
Grapple Skidders	'83	3	2.20	.17	6.00	3.06	11.43
Farm Tractor	'70	1	1.33	.18	1.60	.30	3.41
Front-end Loader	'67	1	1.33	.12	1.60	.30	3.35
Loaders	'82	5	2.66	.30	5.20		8.16
Dozers	'77	4	2.04	.28	7.52	3.50	13.34
Bobtail Truck	'81	1	.19	.01	.25	.08	.53
Diesel Tractor-Trucks	'82	9	.21	.01	.21	.04	.47
Pole Trailers	'77	7				.03	.03
Set-out Trailers	'74	3				.03	.03
Lowboy	'86	1				.05	.05
Medium Pickups	'82	2	.06	.003	.04	.01	.11
Small Pickups	'81	3	.06	.003	.04	.01	.11

Total Operating Cost (Oklahoma Share) = $140,198 (27% of total cost is Oklahoma share)

TABLE XLVII

WEST OKLAHOMA EQUIPMENT FIXED COSTS
(Per hr/mi)

Equipment	Average Year	Number Machines	Depreciation	Interest	Licenses	Taxes	Insurance	Total Fixed Costs
Chainsaws		12	$	$	$	$	$	$
Cable Skidders	'74	3	.40				.43	.83
Farm Tractors	'70	3	.15					.15
Front-end Loaders	'71	4	.17					.17
Loader	'76	1	1.15				.75	1.90
Winch Trucks	'60	2	.05					.05
Bobtail Trucks	'69	10	.02		.01		.07	.10
Gas Tractor-Trucks	'77	3	.04		.01	.01	.07	.13
Diesel Tractor-Trucks	'74	2	.03		.01	.01	.08	.13
Pole Trailers	'77	2	.01				.01	.02
Float	'78	1	.01				.01	.02
Lowboy	'73	1	.01				.02	.03
Forwarder	'77	1	1.50				.81	2.31
Large Pickup	'82	1	.07			.02	.09	
Medium Pickup	'63	1	.01					.01
Small Pickups	'78	5	.02				.01	.03

Total Fixed Cost (Oklahoma share) = $84,187 (100% of total cost is Oklahoma share)

TABLE XLVIII

WEST OKLAHOMA EQUIPMENT OPERATING COSTS
(per hr/mi)

Equipment	Average Year	Number Machines	Fuels	Lubricants	Repair Maint.	Tire/ Track	Total Operating Costs
Chainsaws		12	$	$	$	$	$ 4.00
Cable Skidders	'74	3	1.78	.23	1.67	3.06	6.74
Farm Tractors	'70	3	1.33	.18	1.60	.30	3.41
Front-end Loaders	'71	4	1.33	.12	1.60	.30	3.35
Loader	'76	1	1.78	.56	2.40		4.74
Winch Trucks	'60	2	1.95	.04	1.00		2.99
Bobtail Trucks	'69	10	.19	.01	.25	.08	.53
Gas Tractor-Trucks	'77	3	.19	.01	.25	.08	.53
Diesel Tractor-Trucks	'74	2	.21	.01	.21	.07	.50
Pole Trailers	'77	2				.03	.03
Float	'78	1				.03	.03
Lowboy	'73	1				.05	.05
Forwarder	'77	1	1.78	.23	1.67	3.06	6.74
Large Pickup	'82	1	.06	.003	.04	.02	.12
Medium Pickup	'63	1	.06	.003	.04	.01	.11
Small Pickups	'78	5	.06	.003	.04	.01	.11

Total Operating Cost (Oklahoma share) = $225,844 (100% of total cost is Oklahoma share)

VITA

Martin Wade Toms

Candidate for the Degree of

Master of Science

Thesis: CHARACTERIZATION OF OKLAHOMA'S FOREST HARVESTING INDUSTRY

Major Field: Forest Resources

Biographical:

Personal Data: Born in Opelousas, Louisiana, September 21, 1957, the son of Murry H. and Freda S. Toms, Jr. Married to Debra Sharon Price on April 2, 1983.

Education: Graduated from Saline High School, Saline, Louisiana, in May 1975; received Bachelor of Science Degree in Forest Resources from Louisiana Tech University in May, 1979; completed requirements for the Mastor of Science degree in Forest Economics and Management at Oklahoma State University in May 1987.

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